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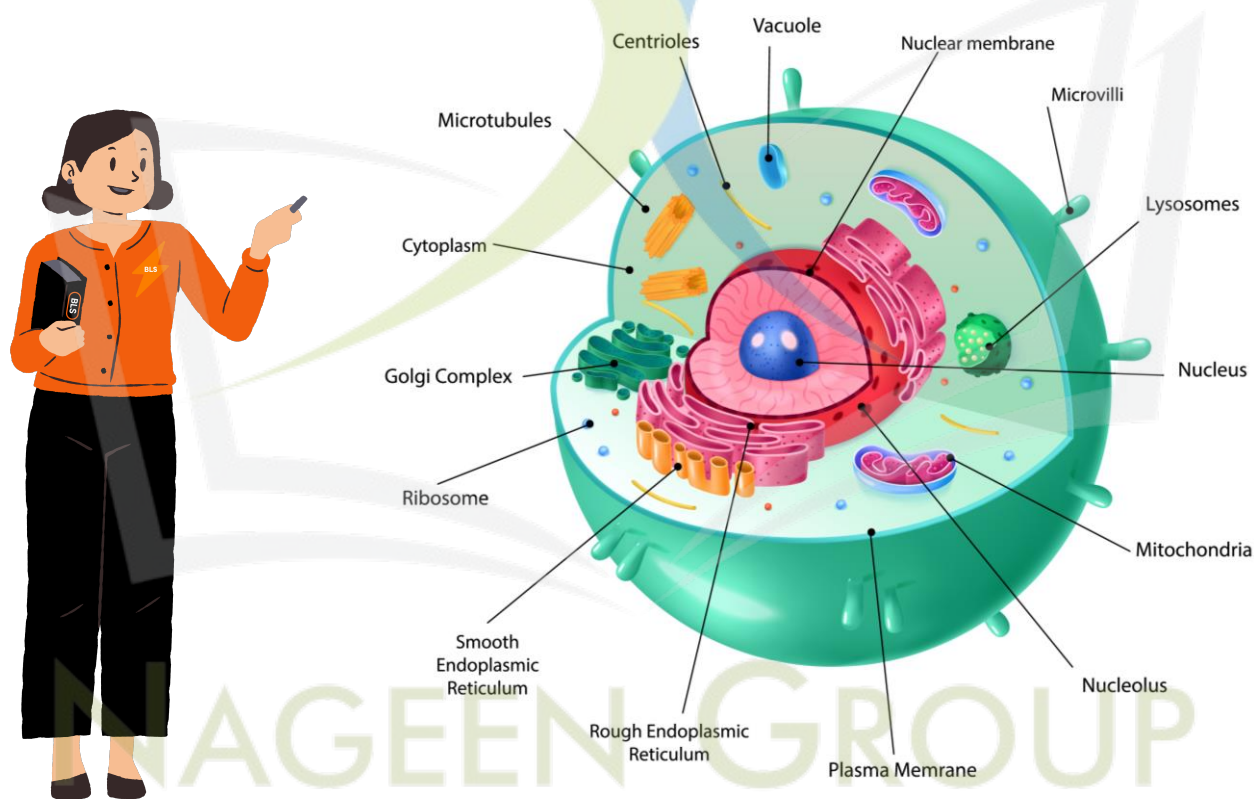
AS PER LATEST CBSE CURRICULUM 2024-25

INTRODUCTION

“A cell is defined as the smallest, basic unit of life that is responsible for all of life’s processes.”

A cell is the structural and fundamental unit of life. The study of cells from its basic structure to the functions of every cell organelle is called Cell Biology. Robert Hooke was the first Biologist who discovered cells.

All organisms are made up of cells. They may be made up of a single cell (unicellular), or many cells (multicellular). Mycoplasmas are the smallest known cells. Cells are the building blocks of all living beings. They provide structure to the body and convert the nutrients taken from the food into energy. Our body is made up of cells of different shapes and sizes.



History of Cell

Cells were discovered for the first time in 1665 by Robert Hooke using a crude microscope.

With a better microscope, Leeuwenhoek observed free-living cells in pond water for the first time in 1674.

The nucleus of the cell was found by Robert Brown in 1831.

Purkinje created the name "protoplasm" for the cell's fluid portion in 1839.

The cell theory, presented by Schleiden in 1838 and Schwann in 1839, states that all plants and animals are made up of cells.

THE FUNDAMENTAL UNIT OF LIFE

INTRODUCTION

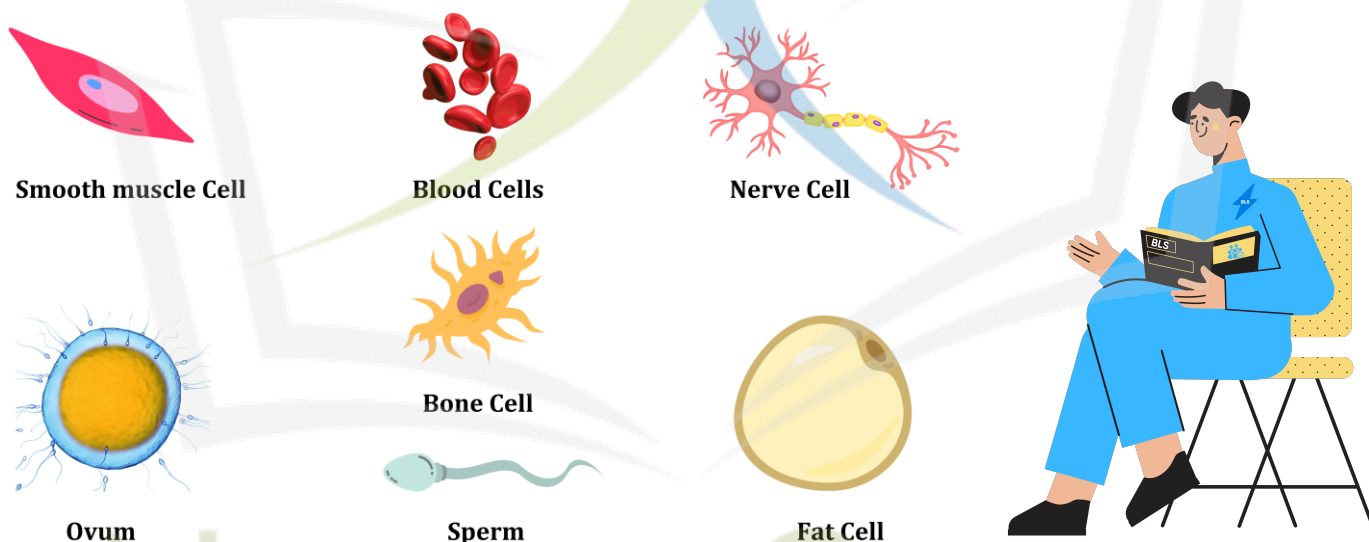
In 1855, Rudolf Virchow advanced on the cell hypothesis by claiming that all cells originate from pre-existing cells.

The discovery of the microscopic universe was made possible by the invention of magnifying lenses. Unicellular creatures have a single cell that performs all tasks such as nourishment, respiration, excretion, and reproduction. Amoeba, Chlamydomonas, Paramecium, and Bacteria, for example, have solitary cells that make up the entire organism.

Multicellular organisms are organisms with a large number of cells that perform many roles. Multicellular organisms might exhibit themselves as a single cell or as a group of cells.

Fungi, plants, and mammals, for example, have many cells that form tissues. A single cell gave rise to every multicellular organism.

As a result, all cells are derived from pre-existing cells. Cells of various types can also be found in some creatures.



The shape and size of a cell are determined by the function it performs. Some cells alter their appearance. Amoeba, for example. In other situations, the cell shape may be more or less fixed and unique to a specific cell type. **E.g.,** nerve cells.

Every live cell has the ability to carry out certain basic operations that are common to all living things. In multicellular organisms like humans, there is a division of labour. This means that various regions of the human body serve diverse purposes.

Within a single cell, division of work is also visible. In reality, each of these cells has unique components known as cell organelles. Each type of cell organelle has a distinct purpose. These organelles allow a cell to live and accomplish all of its activities. The basic unit of the cell is made up of these organelles.

THE FUNDAMENTAL UNIT OF LIFE**INTRODUCTION**

Unicellular Organisms: The organisms that consist of a single cell such as Amoeba.

Multicellular Organisms: The organisms which contain various cells that perform different functions in the organism such as plants fungi and animals.

How can multicellular organisms originate from a single cell?

A cell can divide itself into cells of its own type. Therefore, more cells can generate from an already existing cell.

How can cells perform distinct functions in organisms?

Cells are capable of performing multiple functions in an organism. A cell contains specific components which are called Organelles. Each organelle in the cell can perform different functions such as making new cells or clearing the waste of the cell. Thus, organelles allow a cell to perform several kinds of activities in an organism.



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PLASMA MEMBRANE

This is the outermost covering of the cell that separates the contents of the cell from its external environment. The plasma membrane allows or permits the entry and exit of some materials in and out of the cell.

It also prevents movement of some other materials. The cell membrane is called selectively permeable membrane. It is made up of lipid and protein.

Structure of the Plasma Membrane

The plasma membrane consists of a lipid bilayer, with two layers of lipids forming its foundation. Embedded within this lipid matrix are various proteins that contribute to its functionality. Among these proteins, receptor proteins enable cell communication, while adhesion proteins promote cellular cohesion. Serving as a protective barrier, the membrane regulates the passage of particles, displaying selective permeability that allows small particles to diffuse freely, and larger ones require specific transport channels.

The Fluid Mosaic Model of Plasma Membrane

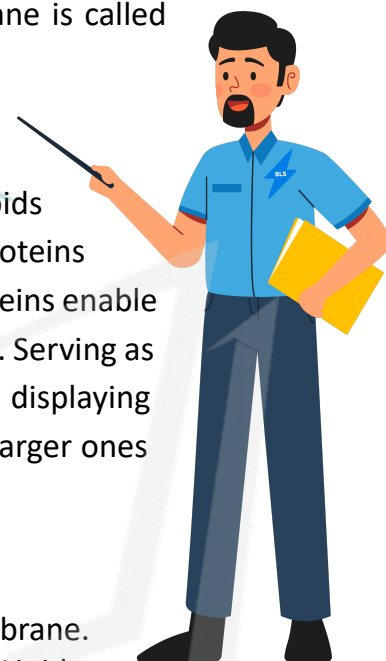
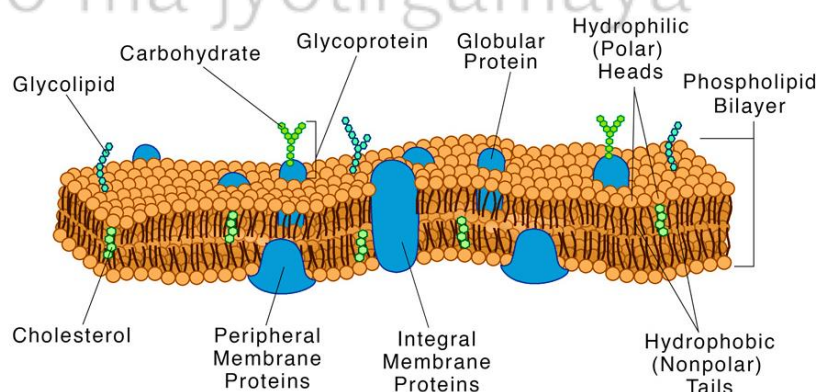
The Fluid Mosaic model explains the structure of the plasma membrane. According to it, the plasma membrane comprises 3 components - Lipids, Proteins and Carbohydrates. These components can flow freely and fluidly inside the plasma membrane.

There are two types of lipids (fats) in the plasma membrane:

Phospholipid: It is a lipid made up of glycerol, two fatty acids, and phosphate. It creates a semi-permeable membrane that allows the flow of only certain materials inside/ outside the cell.

Cholesterol: It is a lipid that provides fluidity to the surface of the plasma membrane.

The proteins act as receptors of the cell and help in transportation across the cell membrane. The carbohydrates attach themselves with the lipids and proteins and are found on the extracellular side of the membrane.



THE FUNDAMENTAL UNIT OF LIFE

PLASMA MEMBRANE

Properties of Plasma membrane

It is flexible (made up of organic molecules called lipids and proteins).

Its flexibility enables cell to engulf in food and other from the external environment. This process is called endocytosis. Amoebae acquire food through this process.

Functions of Plasma membrane

It permits the entry and exit of some materials **in** and out of the cell.

It prevents movement of some other materials **not** required for the cell as it acts like selectively permeable membrane.

Diffusion

The spontaneous movement of a substance from a region of high concentration to the region of low concentration is called diffusion.

Some substances like carbon dioxide or oxygen can move across the cell membrane by a process called diffusion. Cell also obtains nutrition from the environment.

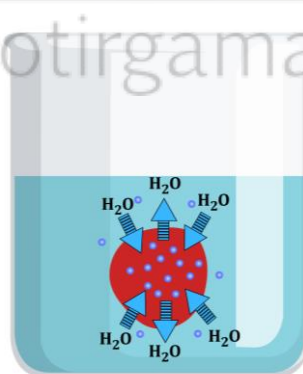
Osmosis

The movement of water molecules through selectively permeable membrane along the concentration gradient is called osmosis.

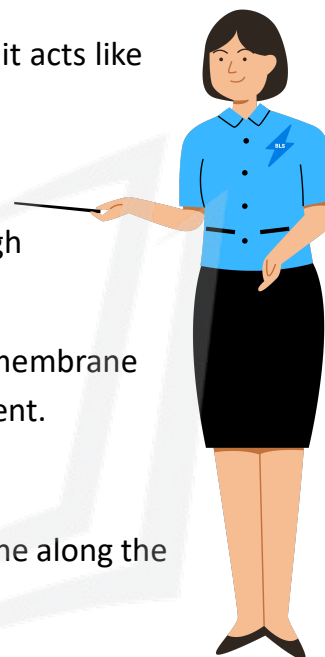
Plant cells tend to obtain water through osmosis.

Hypotonic or Hypertonic or Isotonic solution

Hypotonic Solutions: If the concentration of water outside the cell is higher than the concentration of water inside the cell gains water by the process of osmosis. Water can move into the cell from the cell membrane. In the case of hypotonic solutions, more water enters the cells which result in swelling of the cells.



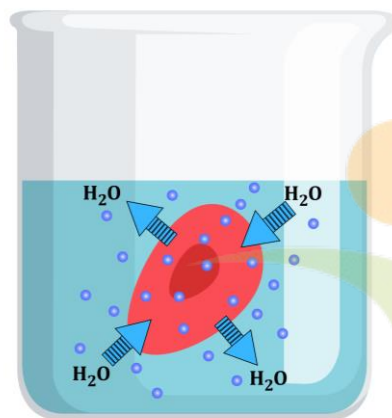
Net water gain
Cell swells



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PLASMA MEMBRANE

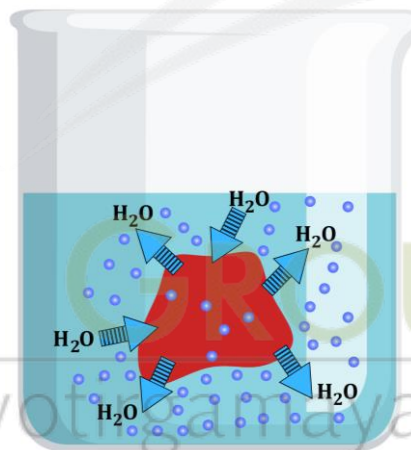
Isotonic Solutions: If the cells are put in an environment that has a similar concentration of water as present inside. This state allows for the free movement of water across the membrane without changing the concentration of solutes on either side. Therefore, the size of the cell does not vary in an isotonic solution because there is no net movement of water.



No net loss or
gain



Hypertonic Solutions: If the cells are kept in an environment that has a lower concentration of water than what is present inside the cells then due to the process of osmosis water moves out of the cells. This results in a decrease in the size of the cells (they shrink) as more water comes out of the cell.



Net Water loss
cell shrinks

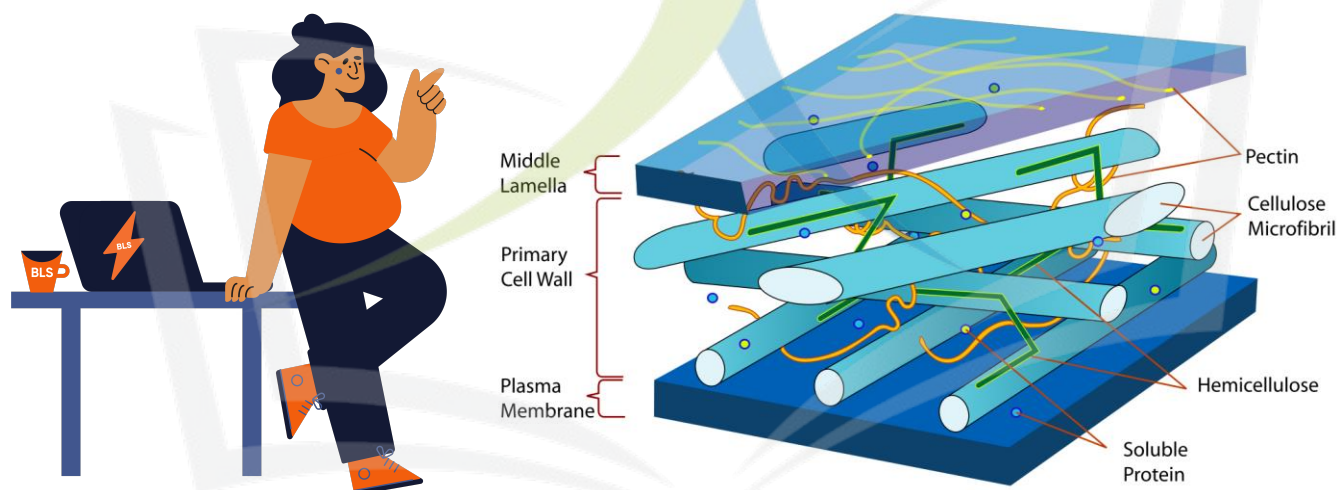


CELL WALL

The cell wall is referred to as the non-living material that protects a cell's outer layer. According to the organism, its composition changes, and it is porous by nature. The cell wall isolates the inner elements from the surrounding environment.

Cell Wall Structure

The cell wall, which is located on the next membrane of the cell also known as the plasma membrane, is the outer layer of a cell. All plant cells, as well as those of, bacteria, and archaea, contain a cell wall. Animal cells have a wavy form, which is mostly caused by the absence of a cell wall. Cell walls typically have different compositions depending on the organism. Plant cell walls typically consist of three layers and a network of carbohydrates like pectin, cellulose, and hemicellulose, as well as trace amounts of other minerals and structural proteins.



There are three main layers:

- ✓ Basic Cell Wall or primary cell wall
- ✓ Middle Lamella
- ✓ Additional Cell Wall or secondary cell wall

Primary Cell Wall: The primary cell, which was the first to build a cell wall, is located nearest to the interior of the cell. Because cellulose makes up the majority of it, the wall may expand to accommodate growth. Pectic polysaccharides and matrix proteins are present in a number of primordial cells. It is also thinner and more porous than the other coats.

Middle Lamella: The middle lamella, which is also the top layer, serves as a connecting point and holds the neighbouring cells together. Pectin makes up the majority of this stratum. However, other materials can also be discovered, including proteins and lignin.

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CELL WALL

Secondary Cell Wall: Once the cell has fully developed, the secondary cell wall is created inside the primary cell wall membrane. Cellulose and lignin are components of some types of cells (particularly those found in xylem tissues), and they contribute extra stiffness and waterproofing. Additionally, this layer gives a cell its typical square or rectangular shape. In addition to being the thickest layer, it allows permeability.

Plasmolysis

Plasmolysis is the process in which cells lose water when they are placed in a hypertonic solution. It causes contraction or shrinking of the plasma membrane away from the cell wall. It is a reversible process and the cell can get back to normal when placed in a hypotonic solution.



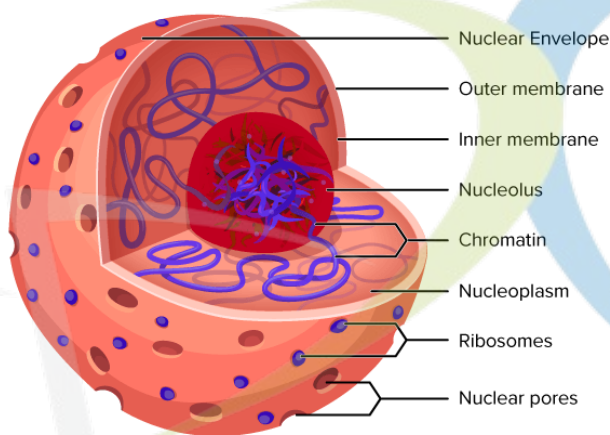
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NUCLEUS

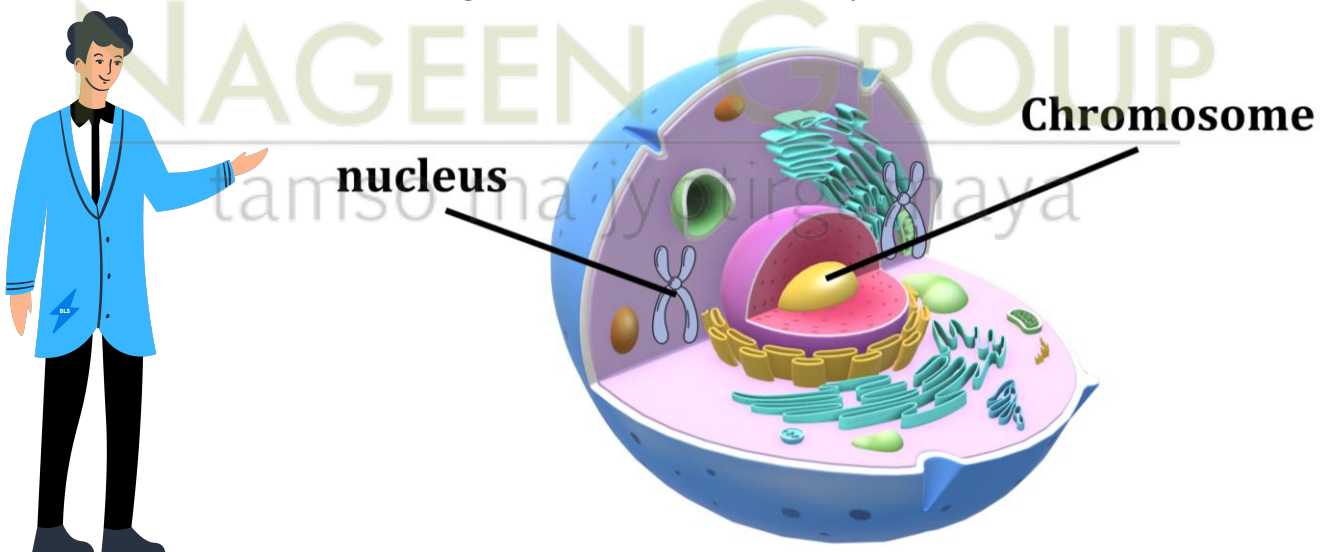
NUCLEUS

The nucleus is the unique characteristic of eukaryotic cells and is only present in eukaryotes. Prokaryotic cells don't have a true nucleus, instead, they have nucleoids.

The nucleus is a double membrane-bound organelle that contains the cell's genetic material in the form of DNA, which is organized into structures called chromosomes. The nucleus is usually the largest organelle in the cell and is covered by a double membrane called the nuclear envelope, on which nuclear pores are present that allow the movement of certain molecules in and out of the nucleus.

**Nucleus of a Cell**

The nucleus is protected by a double-layered membrane known as the nuclear membrane. The nuclear membrane has pores that allow material to pass from the inside to the outside. Chromosomes, which are made up of Deoxyribonucleic acid (DNA) and proteins, are found in the nucleus. The nucleus is in charge of the cell's entire activity.

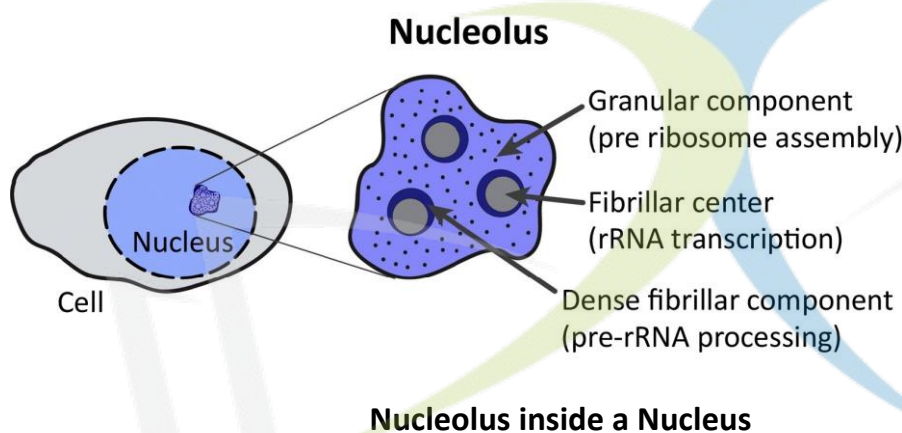


THE FUNDAMENTAL UNIT OF LIFE

NUCLEUS

The nucleus is important in cell division and development because it contains genetic information in the form of DNA. Genes are the functional portions of DNA. Protein synthesis and character transmission from one generation to the next are crucial functions of the nucleus. It is important for cellular reproduction. In some organisms, the nuclear membrane is missing, leaving only nucleic acids (nucleoids) in the nuclear area. Prokaryotes are such creatures. Bacteria, for example. Eukaryotes are organisms that have a nuclear membrane in their cells.

Nucleolus: It is called the Brain of the Nucleus. It comprises 25% of the volume of the nucleus. It consists of proteins and ribonucleic acids (RNA). It helps in the formation of ribosomes which help in the formation of proteins inside the cell.



Nucleoid: Sometimes cells do not have a well-defined nucleus because they lack a nuclear membrane. Such a nucleus with no definite nuclear boundaries is called a Nucleoid.

Functions of Nucleus

The nucleus plays a central role in cellular reproduction. It is the process by which a single cell divides and forms two new cells.

It also plays a crucial part, along with the environment, in determining the way the cell will develop and what form it will exhibit at maturity, by directing the chemical activities of the cell.

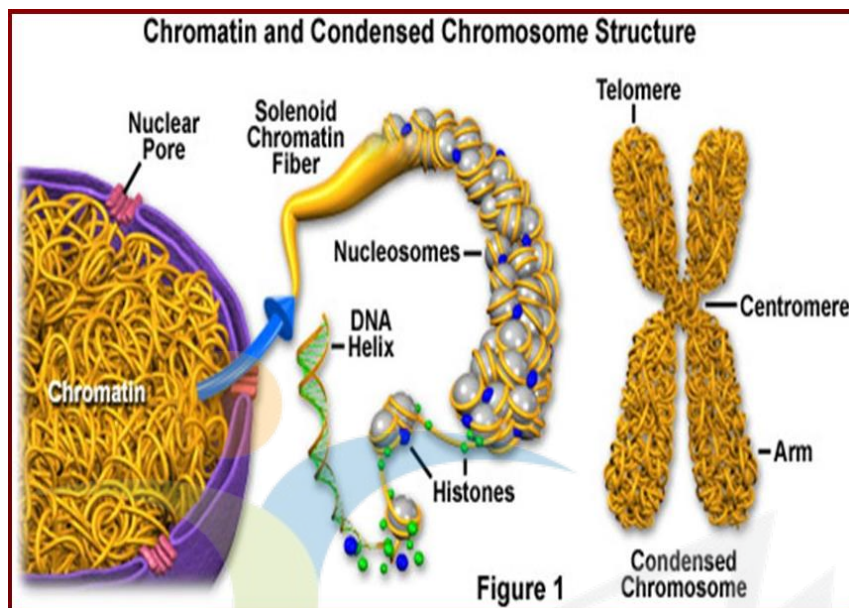
Chromosome

A chromosome is a structure that is composed of DNA and proteins present in the nucleus. These are the thread-like structures that are seen under the microscope at the time of cell division. The DNA is highly coiled over the histone protein that forms the chromatin. Chromatin can further divide into heterochromatin (highly condensed DNA) and euchromatin (loosely packed DNA). Chromosomes are numbered according to their size, with the largest being chromosome 1 and the smallest being the sex chromosomes, X and Y.

Chromatin: Chromatin is thread-like material present in a cell. The chromatin organises itself into chromosomes whenever the cell is about to divide.

THE FUNDAMENTAL UNIT OF LIFE

NUCLEUS



Chromosomes and Chromatin

DNA & RNA

The DNA molecules possess enough information for constructing and organizing the cells. Nucleus also contains RNA (Ribonucleic acid) which directs the synthesis of protein molecule.

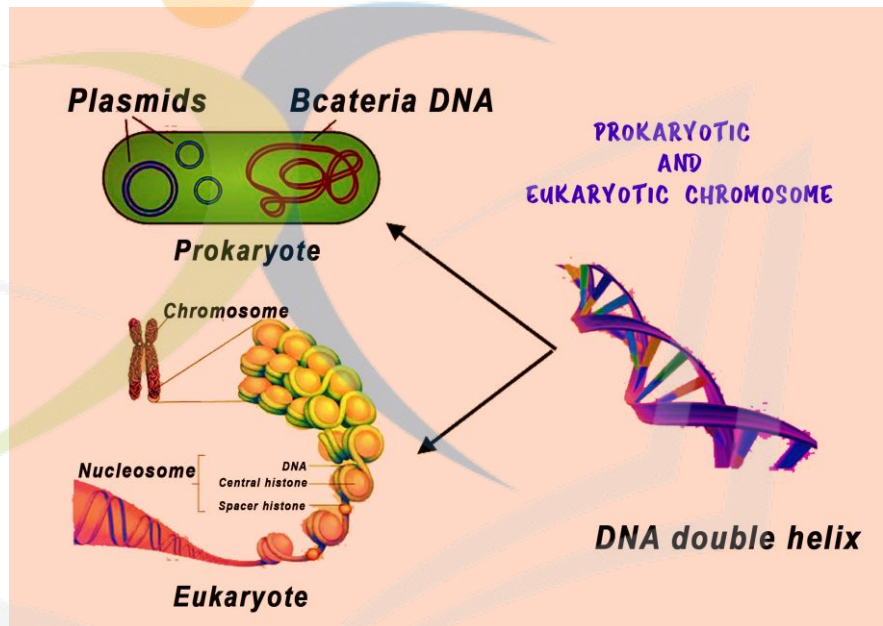
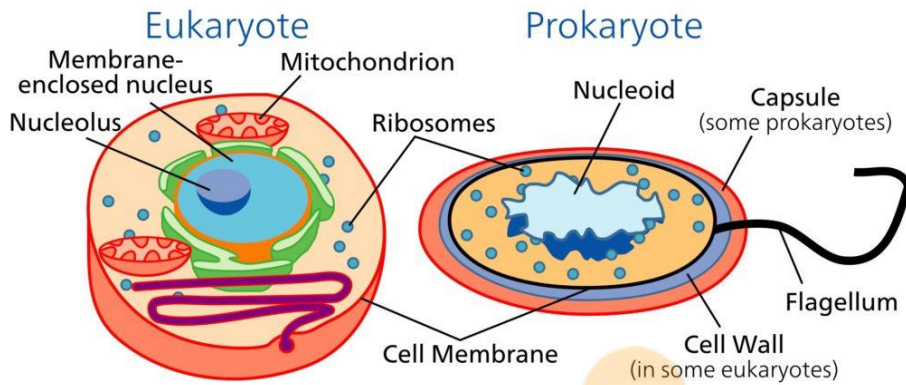
Functions of the Nucleus

- ❖ Nucleus is the chief controller of a cell. It contains chromosomes which carry genes. Genes are responsible for the transmission of hereditary characters from parents to offspring.
- ❖ Nucleus with RNAs help directs the synthesis of structural proteins and other chemical needed for cell growth and cell maintenance.
- ❖ All the metabolic activities of the cell is controlled by the nucleus.
- ❖ It plays a key role in cellular reproduction, a process that involves cell division and produces genetically identical daughter cell by a process known as mitosis.

Prokaryotic Cells	Eukaryotic Cells
Very minute in size	Fairly large in size
Nuclear region (nucleoid) not surrounded by a nuclear membrane	Nuclear material surrounded by a Nuclear membrane
Single chromosomes present	More than one chromosome present
Nucleolus absent	Nucleolus present
Membrane-bound cell organelles are absent	Membrane-bound cell organelles are present
Cell division by fission or budding (no mitosis)	Cell division by mitosis or meiosis

THE FUNDAMENTAL UNIT OF LIFE

NUCLEUS



Prokaryotic and Eukaryotic Chromosome

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THE FUNDAMENTAL UNIT OF LIFE

CYTOPLASM

CYTOPLASM

The fluid content inside the plasma membrane is referred to as cytoplasm. It's a viscous jelly-like substance that covers the entire cell save the nucleus. It also contains a variety of specialised cell organelles, each of which serves a specific purpose for the cell.

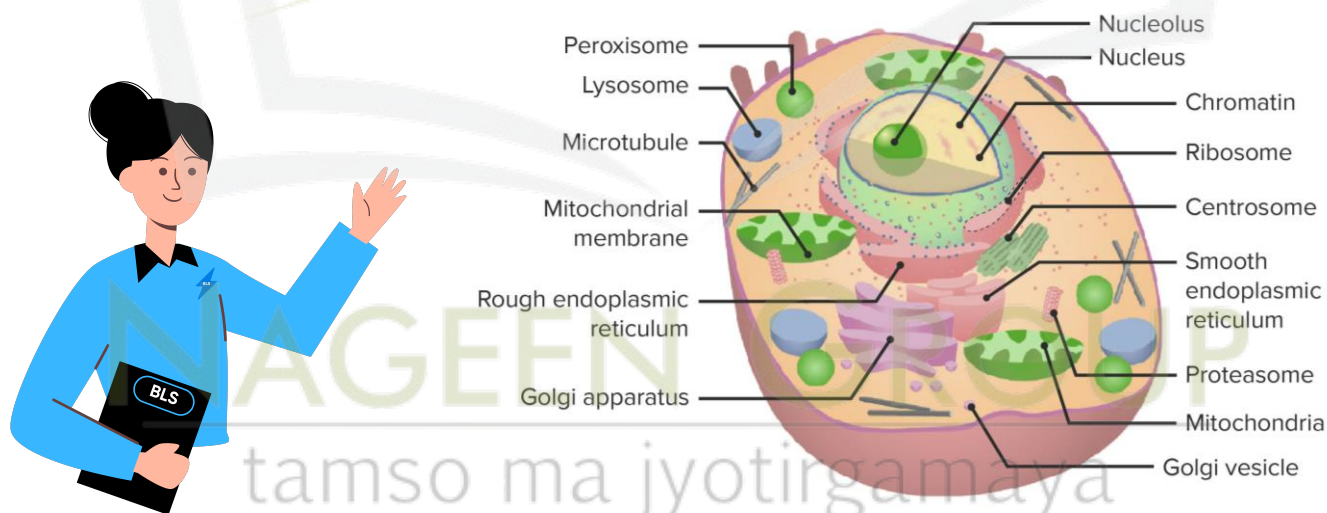
Function of Cytoplasm

- ✓ It helps in exchange of material between cell organelles.
- ✓ It act as store of vital chemicals such as amino acid, glucose, vitamins and iron etc.
- ✓ It is the site of certain metabolic pathways such as glycolysis.

**Cell Organelles**

In the case of Eukaryotic organisms, the cells contain organelles that have their own membranes apart from the overall cell membrane of the cell.

The endoplasmic reticulum, Ribosomes, Golgi apparatus, Mitochondria, Plastids, Lysosomes, and Vacuoles are examples of cell organelles. They're vital since they perform some of the most important jobs in cells.

**Different Cell Organelles****Significance of membrane-bound organelles in a cell**

The cells perform several functions. The organelles are useful because they allow the separation of different functions that are being performed by the cell.

Organelles which carry out important activities in a Cell:

- ✚ Endoplasmic Reticulum

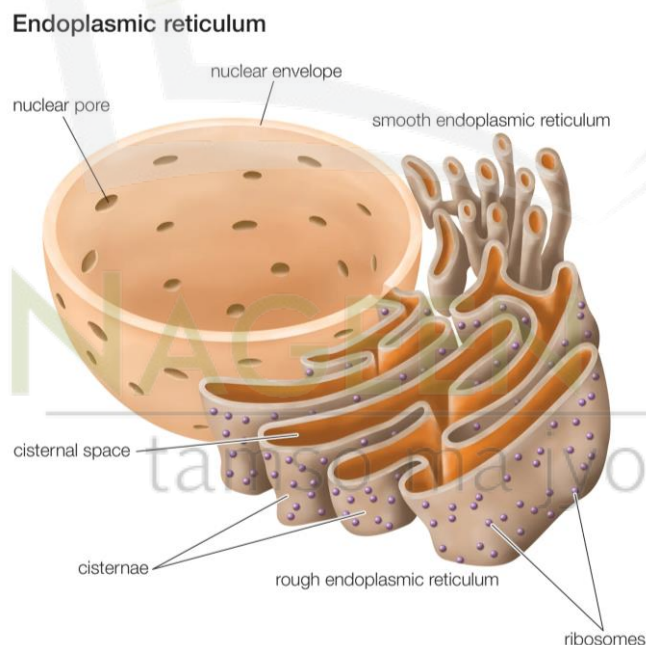
THE FUNDAMENTAL UNIT OF LIFE**CYTOPLASM**

- ✚ Golgi Apparatus
- ✚ Lysosomes
- ✚ Mitochondria
- ✚ Plastids
- ✚ Vacuoles
- ✚ Centrioles
- ✚ Ribosomes
- ✚ Peroxisomes

Endoplasmic Reticulum (ER)

Endoplasmic Reticulum is a large organelle that consists of network of membrane and tubular structures whose primary functions includes the formation, packaging, and secretion of numerous cellular products.

The ER, or endoplasmic reticulum, is a vast network of membrane-bound tubes and sheets. It acts as a conduit for the movement of materials, particularly proteins, between distinct cytoplasmic organs or between the cytoplasm and the nucleus. It also serves as a cytoplasmic scaffolding that provides a surface for certain of the cell's metabolic operations. Rough endoplasmic reticulum and smooth endoplasmic reticulum are the two forms of ER.

**Functions of ER**

Transportation of material between different parts of the cytoplasm and also between the nucleus and cytoplasm

- ✓ Folding of proteins which are synthesised by ribosomes on RER.

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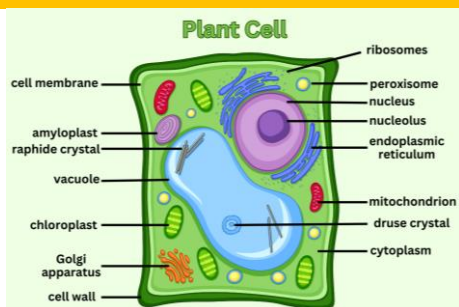
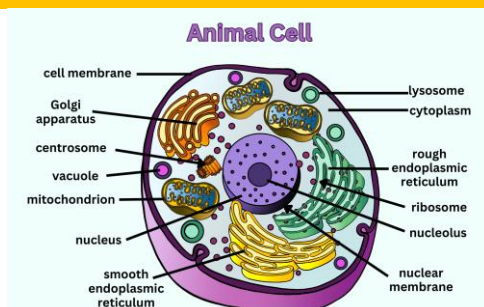
- ✓ Detoxifying poisons and drugs out of the cell is the function of SER.

Rough Endoplasmic Reticulum

- ❖ The RER is made up of phospholipid bilayers, similar in structure to the cell's plasma membrane.
- ❖ RER have ribosomes attached to its cytoplasmic surface. These ribosomes are involved in protein synthesis.
- ❖ The membranes of the RER have number of flattened sacs called cisternae, which are interconnected and allow the exchange of material and information.
- ❖ Inside the cisternae is a central space or lumen which serves as a site where protein synthesis, folding, and modification occur.
- ❖ After synthesis and modification, proteins are packaged into transport vesicles. These vesicles bud off from the RER and carry the proteins to their respective destinations within or outside the cell.

Smooth Endoplasmic Reticulum

- ❖ The SER shares a similar membranous structure with the RER, consisting of a network of tubules and cisternae. However, it lacks ribosomes on its surface, giving it a smooth appearance.
- ❖ A main function of the SER is lipid synthesis and produces phospholipids and steroids, which are essential components of cell membranes.
- ❖ The SER contains enzymes involved in detoxifying drugs and toxins.
- ❖ The SER is responsible for storing and releasing calcium ions (Ca^{2+}). These ions play pivotal roles in various cellular processes, including muscle contraction, cell signalling, and enzyme activation.
- ❖ The SER is involved in various metabolic processes and can serve as a storage site for certain molecules, such as glucose.

Plant cells**Animal cells**

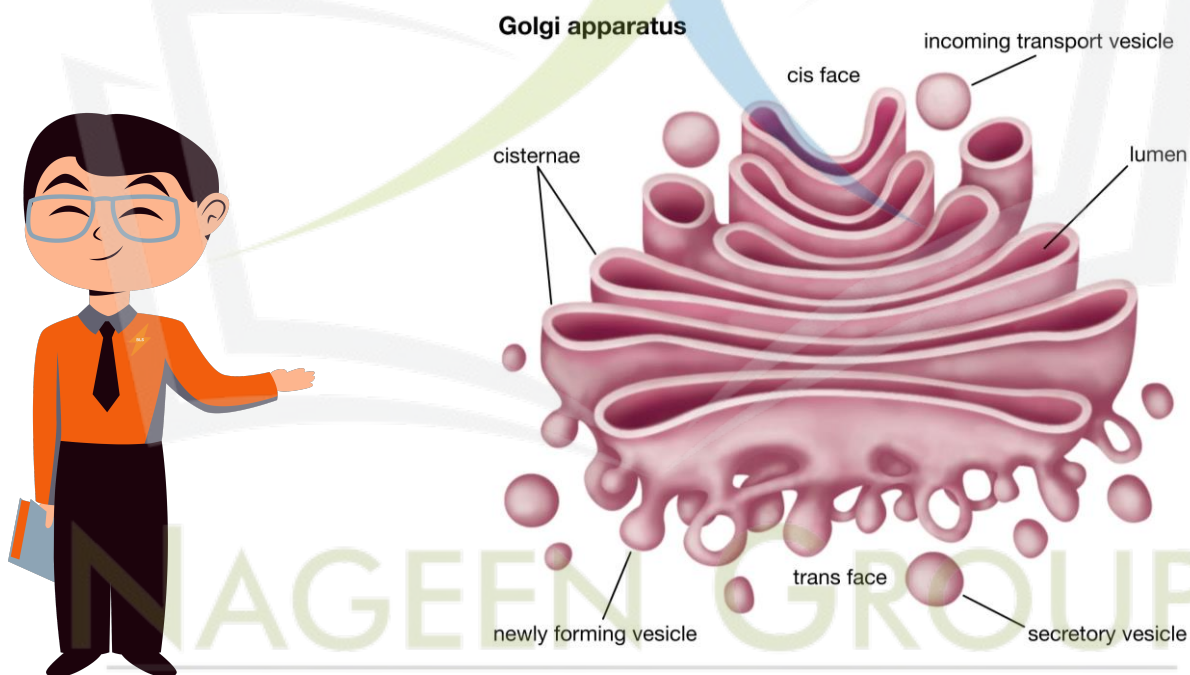
THE FUNDAMENTAL UNIT OF LIFE

CYTOPLASM

Plant cells possess a cell wall.	Animal cells do not possess a cell wall.
Chloroplasts are present in plant cells.	Animal cells do not possess chloroplasts.
Plant cells possess large vacuoles.	Animal cells have many small vacuoles.
Higher plants do not possess centrioles.	Animal cells do contain centrioles.

Golgi Apparatus

Golgi Apparatus (Golgi Body or Golgi complex) is a complex cytoplasmic structure that is made up of smooth membrane saccules or cisternae, and a network of tubules with vesicles and vacuoles. Golgi Apparatus exists as an extensive network near the nucleus in animal cells. However, the plant cells contain many freely distributed subunits of Golgi Apparatus, called dictyosomes. cisternae are formed at one end of the stack, called the cis face of Golgi. They are budded off as vesicles at the other face of the Golgi apparatus, called the trans face of Golgi.



These membranes are frequently connected to the membranes of the ER, and so form part of a complex cellular membrane system. Its responsibilities include storing, modifying, and packing items in vesicles. It has a role in the development of lysosomes as well.

Functions of Golgi Apparatus

Golgi apparatus carries materials synthesised by the ER to different parts of the cell. The material is stored and packaged in vesicles.

- Formation of complex sugar

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CYTOPLASM

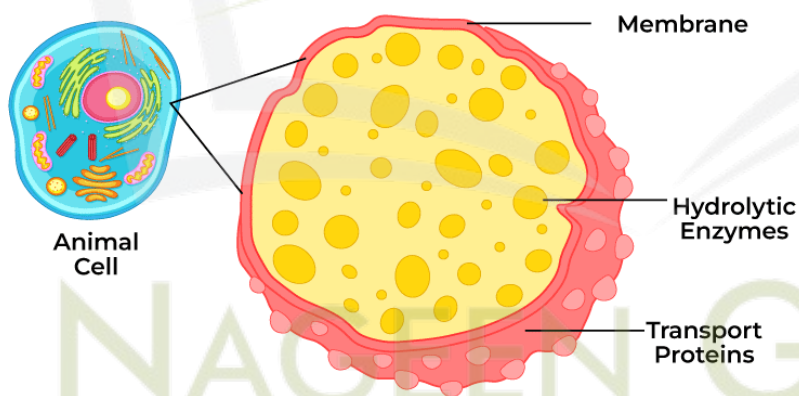
✚ Formation of lysosomes.

Lysosomes

Lysosomes are formed by the joint activity of the endoplasmic reticulum and Golgi complex. All materials that have to be acted upon by lysosome enzymes are usually enclosed inside vacuoles and the vacuoles fuse with the lysosomes for the digestion of materials. Thus, lysosomes take part in the intracellular digestion of various types of materials of endogenous or exogenous origin, extracellular digestion can be performed by them under certain conditions. Lysosomes pass through various stages in the same cell. The phenomenon is called **polymorphism** (the existence of more than one morphological form).

Lysosomes are enzyme-filled membranous sacs. RER produces these enzymes. They are a type of cell waste disposal device. They aid in the cleaning of the cell by digesting foreign substances as well as worn-out cell organelles.

Hydrolytic enzymes in lysosomes are capable of digesting cellular macromolecules. When a cell is damaged, the lysosome may burst, allowing the cell's enzymes to digest it. As a result, lysosomes are referred to as '**suicidal bags**'.



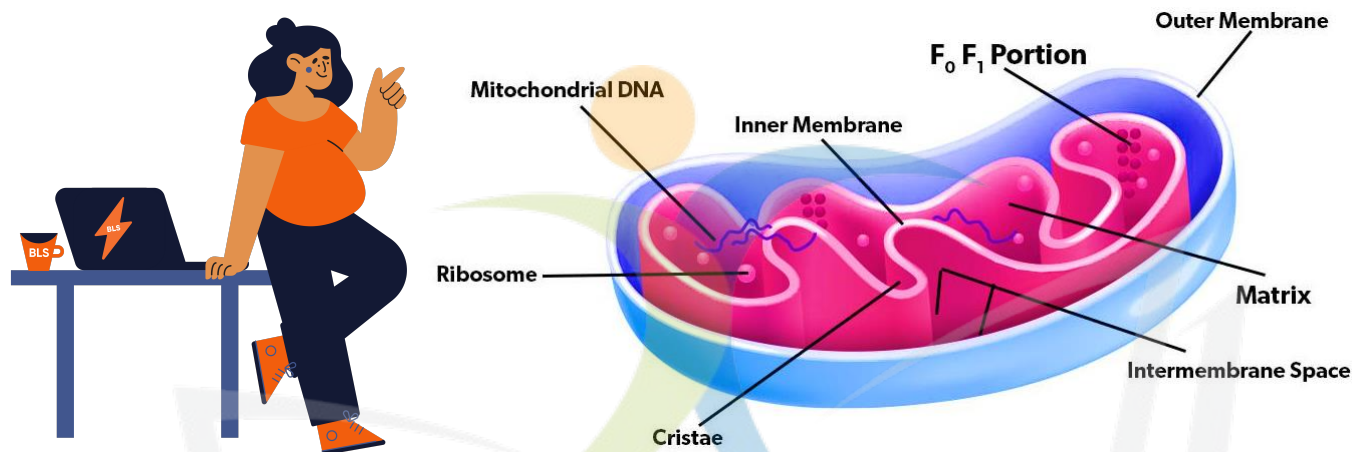
Mitochondria

Mitochondria are cellular organelles that are known as the "powerhouses of the cells." A double membrane separates these from the rest of the body. The exterior membrane is smooth, and the inner membrane is folded into cristae folds. The cristae expand the cellular respiration area. Mitochondria produce ATP molecules, which are used to release energy. ATP is referred to as the cell's "energy currency." Mitochondria have their own DNA, DNA ribosomes and are capable of producing some proteins.

THE FUNDAMENTAL UNIT OF LIFE

CYTOPLASM

It is also known as the mitochondrion. Found in most eukaryotic cells have a double membrane present in the cytoplasm of the cell. One of its popular names is the powerhouse of the cell. It is named so because its main function is to produce ATP for the cell so that cell can perform metabolic activities. ATP (Adenosine Triphosphate) which is used by the cell as chemical energy is produced by aerobic production.

**Functions of Mitochondria**

The primary function of the mitochondria is to generate ATP via oxidative phosphorylation. Other functions of mitochondria are:

- ✚ Helps in ammonia detoxification in liver cells.
- ✚ Regulation of metabolic activity.
- ✚ Helps in cell growth and multiplication.
- ✚ Apoptosis which is a cell death program is also performed by mitochondria.
- ✚ Through the specialized somatic junction's status of microglia is controlled by neuronal mitochondria.
- ✚ Membrane potential and cellular metabolism are maintained by mitochondria.
- ✚ It also contributes to home synthesis reactions and also in steroid synthesis.
- ✚ It is helpful in immune signalling and also in hormonal signalling.

Plastids

Plastid is a two-layered membrane-bound organelle found in the cells of plants that are involved in the synthesis and storage of food. They are fundamental for photosynthesis and the storage of food. Plastids are absent in animal cells. They consist of their own DNA and ribosomes and have the ability to divide.

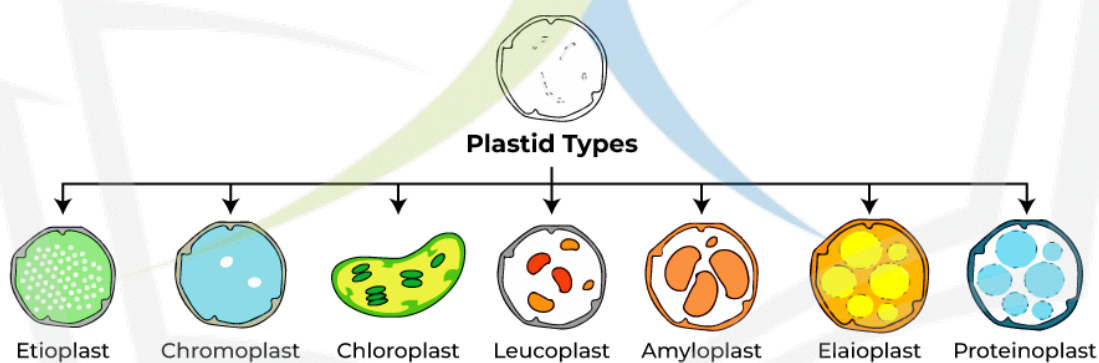
THE FUNDAMENTAL UNIT OF LIFE**CYTOPLASM**

A plastid containing green shade (chlorophyll) is called chloroplast while a plastid containing colors separated from green is known as a chromoplast. A plastid that needs colors is known as a leucoplast and is involved primarily in food capacity.

Types of plastids

Based on the morphology, structure, and color of plastids, they can be divided into the following types. Undifferentiated plastids are called “proplastids” which are found basically in meristematic tissues. Proplastids might form later into any of the different plastids.

- Chloroplasts
- Chromoplasts
- Gerontoplasts
- Leucoplasts

**Chloroplasts**

Chloroplasts are cell organelles that conduct photosynthesis in plants. It is derived from two Greek words Chloro and Plants which means green and plants respectively. Chloroplasts contain photosynthetic pigments called 'Chlorophyll' along with lipids, carbohydrates, minerals, DNA, RNA, grana, thylakoids and stroma.

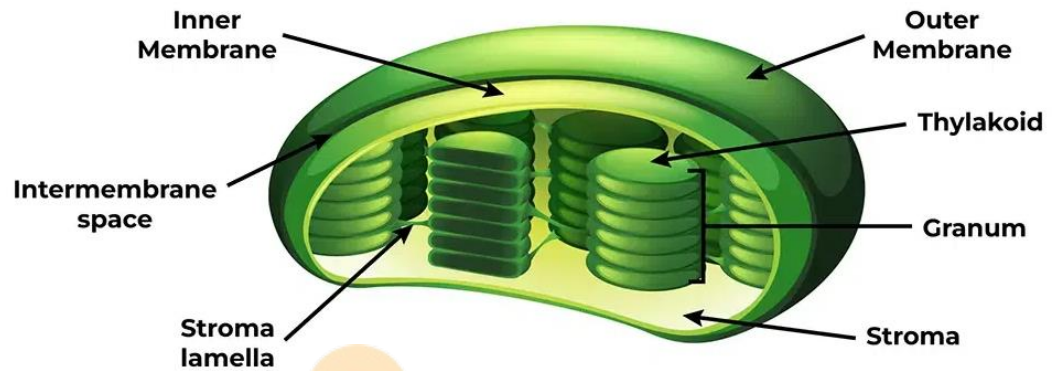
The main functions of chloroplasts are:

- ✓ Conducting photosynthesis in plants.
- ✓ Protein synthesis
- ✓ Releases oxygen
- ✓ Storage of Starch



THE FUNDAMENTAL UNIT OF LIFE

CYTOPLASM



Light-dependent Reactions in Photosynthesis – During photosynthesis chlorophyll absorbs the light energy which is then used for two molecules ATP and NADPH.

Thylakoids: They are pillow-shaped compartments in the chloroplast. The light-dependent reactions in photosynthesis take place in the thylakoids.

Stroma: It is a fluid-filled matrix in the chloroplasts. It is a colourless fluid that contains all the enzymes that are needed for the light-dependent reactions in Photosynthesis.

Grana: Stacks of thylakoids are called Grana. They are found in the stroma. They provide a large surface area so that the reactions of photosynthesis can take place.

Chromoplasts

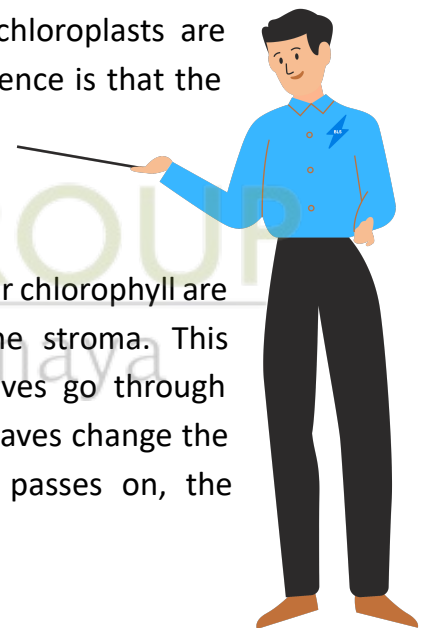
Chromoplasts are the other pigmented plastids that are all not green. These are tracked down in flowering plants, organic products, and mature leaves. At times chloroplasts are considered as chromoplast since they are pigmented, but the difference is that the green chlorophyll plays in photosynthesis.

Gerontoplasts

Gerontoplasts are old chloroplasts. The thylakoid films and the leftover chlorophyll are separated by gathering plastoglobuli, lipoprotein particles, in the stroma. This progress from chloroplast to gerontoplast happens when the leaves go through senescence or decay with age. During the pre-winter months, the leaves change the tone and afterward bite the dust and tumble off. As the leaf passes on, the gerontoplasts are overwhelmed and processed via autophagosomes.

Leucoplasts

Leucoplasts are the non-pigmented organelles that are found in the non-photosynthetic pieces of the plant, like the roots.



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They might turn out to be basically stockpiling sheds for starches, lipids, and proteins based on the plant's needs. They are all the more promptly utilized for orchestrating amino acids and unsaturated fats.

There are three types of leucoplasts:

Amyloplasts-Amyloplasts store and synthesize starch.

Proteinoplasts-They stores the proteins and can be typically found in seeds.

Elaioplasts-They help in storing fats and oils.

Amyloplast

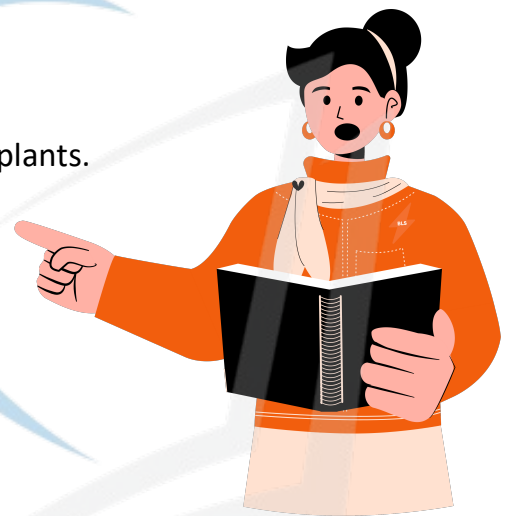
- ✓ They are found in tubers, cotyledons and endosperm in plants.
- ✓ They are used to store starch.

Elaioplast

- ✓ They are found in epidermal cells of the plants
- ✓ They store oil.

Proteinoplast

- ✓ They are found in seeds and nuts.
- ✓ They store proteins.



Vacuoles

Vacuoles are the places where cells can store liquids and solids. They are present in both plants and animals but the plant vacuoles are bigger in size than the animal vacuoles.

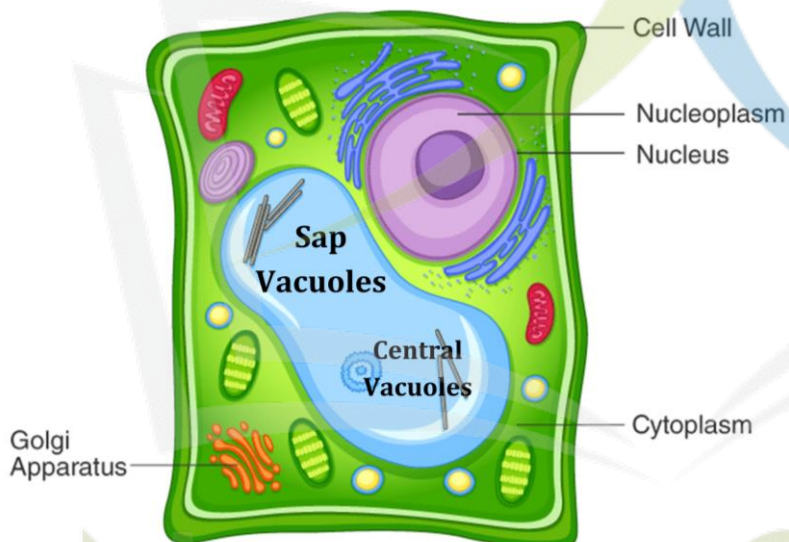
Plant Cell Vacuoles	Animal Cell Vacuoles
Plant cell vacuoles store all the material that is required for the plant to stay alive such as water.	Animal cell vacuoles contain food items in unicellular organisms.
Plant vacuoles maintain the turgidity of the plant cell.	Animal vacuoles can also expel water and waste out of the cell.
Plant cells generally contain a single large vacuole.	Animal cell contain several small vacuoles.
Plant vacuoles are present in the centre of the cell.	Animal vacuoles are scattered throughout the cell.

THE FUNDAMENTAL UNIT OF LIFE**CYTOPLASM****Types of Vacuoles**

- Sap Vacuoles
- Contractile Vacuoles
- Food Vacuoles

Sap Vacuoles

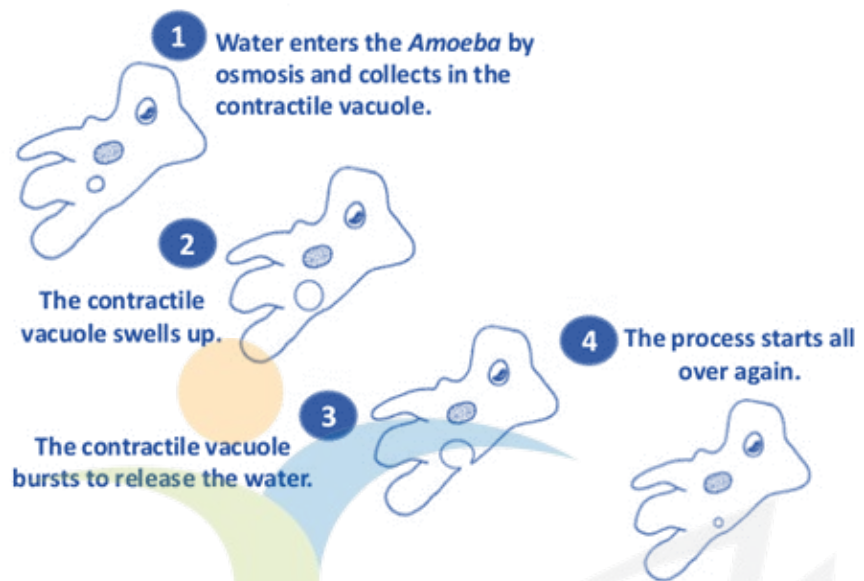
These vacuoles are filled with a fluid called **Vascular Sap**. The fluid contains Amino Acids, Salt, Sugar, Proteins, Water, and Waste Materials. Sap vacuoles are separated from the cytoplasm by a semipermeable membrane called Tonoplast. Their main function is to allow rapid exchange between the cytoplasm and the surrounding environment. Several sap vacuoles are found in young plant cells and animal cells. In mature plants, the small sap vacuoles combine to form a single large central vacuole.

**Contractile Vacuoles**

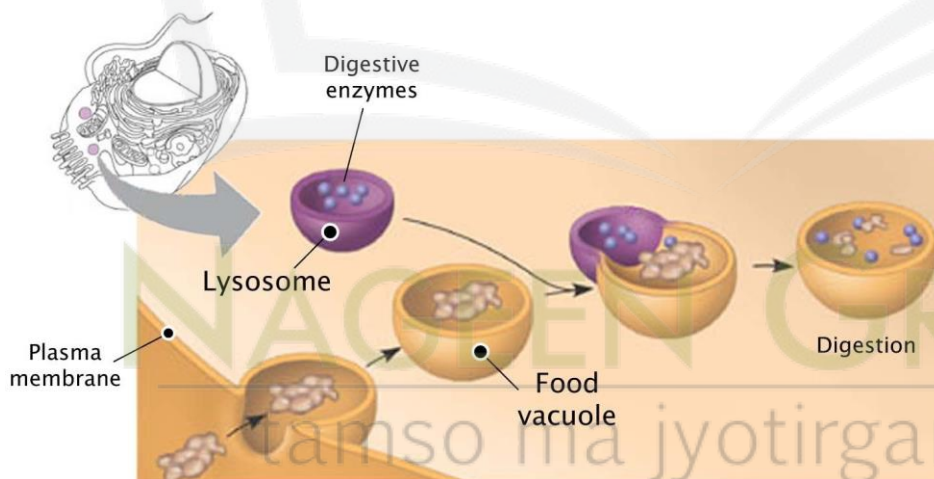
They are found in protistan and algal cells in freshwater. The membrane of the contractile vacuoles is highly extensible and collapses easily. These vacuoles are responsible for osmoregulation (maintaining the water content of the cells) and excretion in the cells.

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Osmoregulation in *Amoeba* through Contractile VacuolesFood Vacuoles

They are found in the cells of protozoans and several lower animals. Food vacuoles are responsible for the digestion of food in the cells as they contain food enzymes. The digested food then passes into the cytoplasm. Found in single-celled organisms like *Amoeba*.



Food Vacuoles and Digestion

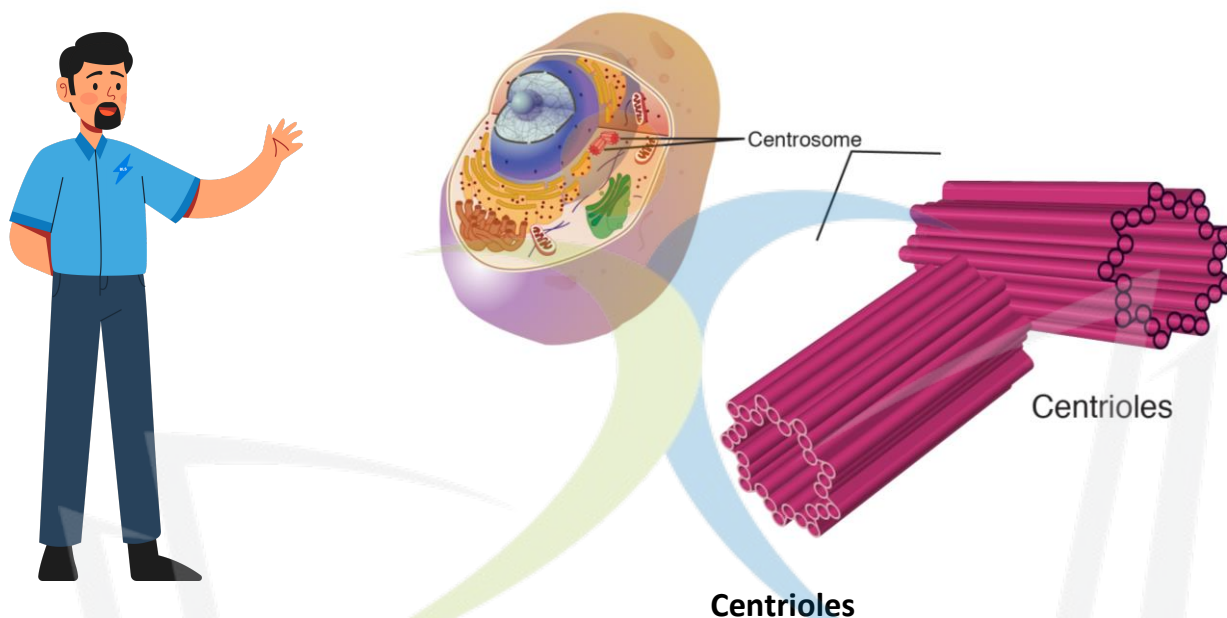
Centrioles

- A centriole is a small set of microtubules arranged in a specific way.
- Their main purpose is to help a cell in cell division.
- They are found near the nucleus but can be seen only during the cell division.

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- They are found in pairs and form a special substance called Centrosome which appears near the nucleus.
- When the cell divides, the centrosome divides into two parts and each part moves to opposite sides of the cell.



Ribosomes

- ✚ They are cell organelles responsible for protein synthesis.
- ✚ Ribosomes can be found in both prokaryotes and eukaryotes because the synthesis of proteins is important in both of them.
- ✚ In prokaryotes, the ribosomes float freely in the cytoplasm.
- ✚ In eukaryotes, they can be found floating in the cytoplasm, or they are often attached to the endoplasmic reticulum.
- ✚ The ribosomes attached to the ER synthesise proteins that are to be exported out of the cell while the ribosomes floating inside the cell synthesise proteins that are used inside the cell.

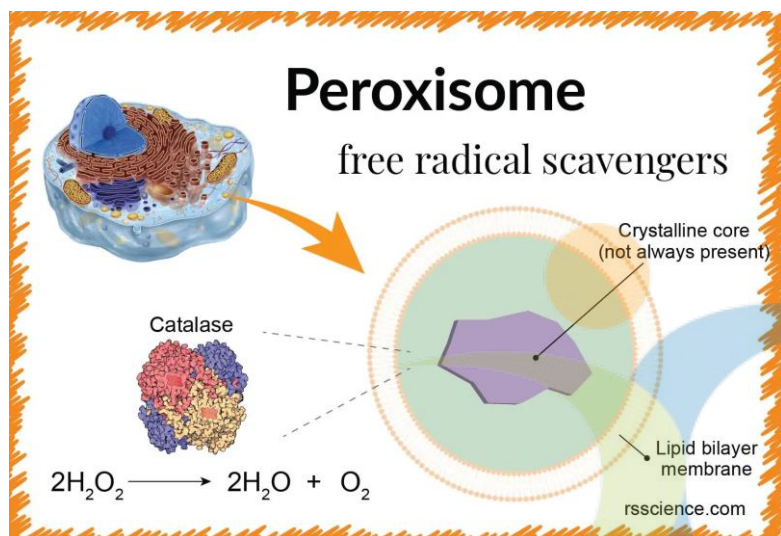
Peroxisomes

- ✚ Peroxisomes are small vesicles found in the cells.
- ✚ These enzymes are used to break the toxic materials inside the cell.
- ✚ They digest the fatty acids of the cell as well as amino acids by carrying out oxidation reactions in the cell.

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- ✚ They are also responsible for the digestion of alcohol in the human body. Hence, the liver contains a large number of Peroxisomes.



Peroxisomes in a cell



The Fundamental Unit of Life

DPP-01

[Topic: What are Living Organisms Made up of]

Very Short Answer Type Questions

1. Why is the cell called the structural and functional unit of life?
 2. Name the largest cell of living world.
 3. What is the size of human egg cell?
 4. Which functions are performed by a single cell organism like amoeba?
 5. How many types of different cells are present in our body?
 6. Name two cells with cell wall.
 7. Name the animal cell which does not possess nucleus.
 8. Name the stain which is commonly used to stain onion peel cells? Which part of the cell is stained by it?
 9. What is a cell?
 10. Which is the longest cell in the human body?
 11. Who proposed cell theory?
 12. Which chemical is used to stain human cheek cells?
 13. While preparing a temporary mount, why should the peel be kept in water?
 14. Why is the cell called the structural and functional unit of life?
 15. What is the basis of microscopy? Invention of which simple device made the discovery of microscope possible?
 16. The shape and size of cells are related to the specific function they perform. Is it true for a unicellular organism?
 17. What is a cell made up of?
- OR**
- Describe the structural organisation of a cell?
18. How is a cell organised to interact with its environment and yet functions like an independent unit?

Short Answer Type Questions-I

19. Who discovered the cell and how?
20. Give specific functions which are performed by the cells in our body.
21. Why does a person become paralysed?

22. Why is red blood cells biconcave in shape?
23. Why does red blood cell contain red pigment haemoglobin?
24. Why does a nerve cell has a branched endings and a long thread like structure?
25. How do cells keep organisms alive?
26. What were the observations made by Robert Hooke while examining a thin slice of cork through a self-designed microscope?
27. On preparing temporary mounts of peels of onions of different sizes do we see different sizes of cell? Will they possess different inner structures too?
28. Identify the diagram and structure X.



29. Why are some organisms called unicellular organisms? Do we belong to this category? Elaborate.
30. Every multi-cellular organism has come from a single cell. How?
31. How does a living cell perform these basic functions?

OR

There is a division of labour in multicellular organisms such as human beings. Does it apply to a cell and its components too? Justify your answer through examples.

32. Which type of cells contain cell wall? Give one example.

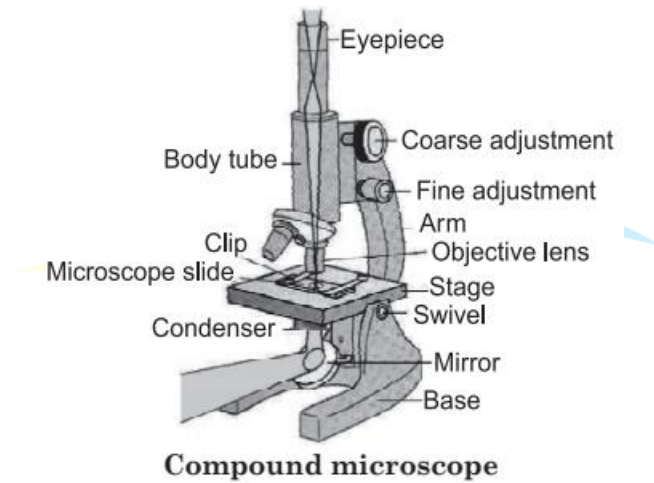
Short Answer Type Questions-II

33. What is fundamental unit of life? Who discovered it? How can they be observed?
34. What is difference between unicellular organism and multicellular organism? Give an example of each.

Long Answer Type Questions

35. (a) Who discovered the cell? Which major invention led to the discovery of microscopic world?
(b) Name a single cell which may constitute a whole organism. What are they called?
(c) Every multicellular organism has come from a single cell. Justify the statement.
36. Answer these questions after observing the given figure.
(i) What is the use of mirror and condenser?
(ii) When do we use screws for coarse adjustment and fine adjustment?

- (iii) Which of the lenses can be rotated? Why are they rotated?
- (iv) Name the lenses present in the microscope? What is the nature of lenses?
- (v) How do we hold a microscope while transporting in the room?



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The Fundamental Unit of Life

DPP-02

[Topic: What is a Cell Made up of, Structural Organisation of a cell]

Very Short Answer Type Questions

1. Why is plasma membrane called a selective permeable membrane?
2. Which cell organelle is called 'Head quarter' of the cell?
3. What is the composition of protoplasm?
4. Name the process through which unicellular fresh water organisms and most plants tend to gain water.

OR

Name the process in which diffusion take place through a selectively permeable membrane.

5. What is the nuclear region of the prokaryotic cells called?
6. Where is the genetic material of a eukaryotic cell present?
7. Name an instrument which helps to see structure of plasma membrane.
8. Where are ribosomes synthesized?
9. A cell placed in a solution swells up. What is the nature of the solution?
10. Who gave the fluid mosaic model of plasma membrane?
11. What happen to an animal cell if placed in the hypertonic solution?
12. Where is the nucleus located in human cheek cells?
13. Name the process in which movement of solvent into cell takes place.
14. List two properties of cell wall.
15. What is the shape of nucleues?
16. Which is the outer most layer in (i) animal cells (ii) plant cell
17. Why do dry apricot placed in water swell?
18. Name the only cell organelle seen in prokaryotic cell.
19. What is plasmolysis?
20. What will happen to a cell if the concentration of water molecules in the cell is higher than the concentration of water molecules in surrounding medium?
21. Give a function of Ribosomes?
22. Which organelles other than nucleus, contain DNA?
23. Who stated "cell arises from pre-existing cell"?
24. Why does the skin of your finger shrink when you wash clothes for a long time?

25. If you are provided with some vegetables to cook. You generally add salt into the vegetables during cooking process. After adding salt, vegetables release water. What mechanism is responsible for this?
26. Human RBCs placed in distilled water burst but a spirogyra cell doesn't. Why?
27. Which of the organelles are double membrane?
28. Where is the nuclear or genetic material present in bacteria?

Short Answer Type Questions-I

29. How do substances like CO_2 and water move in and out of the cell? Discuss.
30. What is plasma membrane made up of? Is it tough or flexible?
31. What would happen if the plasma membrane ruptures or breaks down?
32. What is difference between diffusion and osmosis?
33. What will happen when a human red blood cells is placed in hypertonic salt/sugar solution?
34. Where is cell membrane present in animal and plant cells?
35. What is thickness of a plasma membrane?
36. Name the three components which are present in all cells.
37. Any four properties of plasma membrane or cell membrane.
38. If a cell is kept in hypertonic or hypotonic solution, does water move only in one direction or both? Clarify.
39. What are the factors on which movement of water across membrane depend? List any two and exemplify them.
40. Is osmosis same as diffusion?
41. How does cell wall help a cell?

Short Answer Type Questions-II

42. How will you prove that plasmolysis is due to exosmosis and not due to diffusion or some other type of movement?

OR

- How will you set up an experiment to demonstrate plasmolysis?
43. How would the observation be different in following situations? Give reasons too.
 - (i) When we put iodine solution on the peel
 - (ii) We use safranin solution to stain the cells.
 - (iii) We use methylene blue solution to stain the cells.
 44. Describe the structure of a nucleus? Discuss functions of its components too.
 45. Discuss functions of nucleus.
 46. How does a photosynthetic bacteria differ in structure from the cell of a green alga?

47. Draw labelled diagram of Prokaryotic cell.

48. How can importance of membranes be illustrated through viruses and other cells?

Long Answer Type Question

49. How does the movement of substances take place into the cell? How do substances move out of the cell? Discuss these processes emphasising their significance in the living world.

The Fundamental Unit of Life

DPP-03

[Topic: Cell Organelles]

Very Short Answer Type Questions

1. Which organelles is called the Kitchen of a cell?
2. Name an organelle without a cell membrane i.e. non-membranous?
3. How many membranes are present in vacuole?
4. Which cell organelle synthesizes lipids?
5. Where do lysosomes arise?
6. Which plastid is responsible for yellow and other colours in petals of flower?
7. Which is the largest organelle of the plant cell?
8. Can you name the two organelles which contain their own genetic material?
9. If the organisation of a cell is destroyed due to some physical or chemical influence, what will happen?
10. Why are lysosomes known as suicide bags?
11. Where are proteins synthesized inside the cell?
12. What would happen to the life of a cell if there was no Golgi apparatus?
13. Which organelle is known as the powerhouse of the cell? Why?
14. Where do the lipids and proteins constituting the cell membrane get synthesised?
15. What are chromosomes?
16. How many chromosomes are present in human cells?
17. The fibres in fruits and vegetable are made up of which material? Is it the same material which is also used for making paper?
18. Name the processes by which (a) water (b) mineral salt are absorbed into the root hairs.
19. Lipid molecules in the cell are synthesised by
 - (a) smooth endoplasmic reticulum
 - (b) rough endoplasmic reticulum
 - (c) golgi apparatus
 - (d) plastids
20. Which cell organelle would you associate with elimination of old and worn out cells and why?

Short Answer Type Questions-1

21. Make a comparison and write down the ways in which plant cells are different from animal cells.

22. What is meant by the division of labour among cells? Explain its importance.
23. Lysosomes, mitochondria, plastids and vacuoles are important because they carry out some very crucial functions in cells. Choose the ones which synthesize some molecules and name the molecules too.

Short Answer Type Questions-II

24. State two differences between mitochondria and plastid.
25. Draw a neat labelled diagram of an animal cell.
26. Name the organelles which show the analogy written as under:
- (a) Transporting channels of the cell
 - (c) Packaging and dispatching unit of the cell
 - (d) Digestive bag of the cell
 - (f) Kitchen of the cell
27. Name the control room of the cell and show its components.
28. Write the name of different plant parts in which chromoplast, chloroplast and leucoplast are present.
29. Draw a neat diagram of plant cell and label any three parts which differentiate it from animal cell.

Long Answer Type Questions

30. (a) Draw a plant cell and name the seven important organelles found in it.
 (b) Name one organelle that can make some of its protein in a plant cell and also mention one function of such organelle.
31. (a) Name and draw a cell which does not have a well-defined nuclear region. Label any four parts.

OR

Draw a neat and labelled diagram of a typical prokaryotic cell.

(b) Mention two ways by which a photosynthesing cell belonging to this group differs from a cell of your body.

32. Fill the blanks in the table given below.

S.No.	Organelle	Structure	Type (if any)	Function
1.			chloroplast	
2.				produces ATP
3.		vesicles with hydrolytic enzymes		

4.			SER/RER	
5.	ribosome			
6.	Golgi apparatus			lipid synthesis



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THE FUNDAMENTAL UNIT OF LIFE**INTRODUCTION****(Practice Sheet)**

- 1 Who is credited with the discovery of cells?**
A. Anton van Leeuwenhoek B. Robert Hooke
C. Rudolf Virchow D. Matthias Schleiden
- 2 In what year did Rudolf Virchow propose that all cells originate from pre-existing cells?**
A. 1674 B. 1831
C. 1855 D. 1839
- 3 Which scientist coined the term "protoplasm" for the fluid portion of the cell?**
A. Robert Brown B. Anton van Leeuwenhoek
C. Matthias Schleiden D. Purkinje
- 4 What is the fundamental unit of life?**
A. Molecule B. Atom
C. Organelle D. Cell
- 5 Which organelle was discovered by Robert Brown in 1831?**
A. Mitochondria B. Nucleus
C. Endoplasmic Reticulum D. Golgi Apparatus
- 6 Differentiate between unicellular and multicellular organisms, providing examples for each.**
- 7 How did the invention of magnifying lenses contribute to the discovery of the microscopic universe?**
- 8 What are the roles of the organelles in the cell?**
- 9 What was the significance of Rudolf Virchow's contribution to the cell theory?**
- 10 How does the shape and size of a cell relate to its function?**

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THE FUNDAMENTAL UNIT OF LIFE**PLASMA MEMBRANE****(Practice Sheet)**

- 1 What is the main function of the plasma membrane?**
 - A. Energy production
 - B. Waste elimination
 - C. Regulation of cell entry and exit
 - D. Protein synthesis
- 2 What is the structure that forms the foundation of the plasma membrane?**
 - A. Carbohydrates
 - B. Lipid bilayer
 - C. Cholesterol
 - D. None of these
- 3 Which protein type in the plasma membrane enables cell communication?**
 - A. Adhesion proteins
 - B. Receptor proteins
 - C. Transport proteins
 - D. Enzymatic proteins
- 4 What model explains the fluid and dynamic nature of the plasma membrane?**
 - A. Rigid Matrix Model
 - B. Solid Structure Model
 - C. Fluid Mosaic Model
 - D. Static Layer Model
- 5 What is the role of cholesterol in the plasma membrane?**
 - A. Provides energy
 - B. Enhances rigidity
 - C. Provides fluidity
 - D. Promotes cell division
- 6** What is the primary component of plasma membrane?
- 7** What are the main components of the Fluid Mosaic Model of the plasma membrane?
- 8** How does cholesterol contribute to the fluidity of the plasma membrane?
- 9** Explain the term "selectively permeable membrane" in the context of the plasma membrane.
- 10** What is the role of adhesion proteins in the plasma membrane?

THE FUNDAMENTAL UNIT OF LIFE

CELL WALL

(Practice Sheet)

- 1 What is the main function of the cell wall?
 - A. Energy production
 - B. Protection
 - C. Cellular respiration
 - D. DNA replication
- 2 Which of the following is NOT a component of plant cell walls?
 - A. Cellulose
 - B. Pectin
 - C. Cholesterol
 - D. Hemicellulose
- 3 Which layer of the cell wall serves as a connecting point between neighboring cells?
 - A. Primary Cell Wall
 - B. Middle Lamella
 - C. Secondary Cell Wall
 - D. Plasma Membrane
- 4 What is the primary component of the Primary Cell Wall?
 - A. Lignin
 - B. Cellulose
 - C. Pectin
 - D. Hemicellulose
- 5 In which type of cells can the Secondary Cell Wall be found?
 - A. Animal cells
 - B. Bacterial cells
 - C. Plant cells
 - D. Archaeal cells
- 6 What is the function of the middle lamella in the cell wall?
- 7 What are the three main layers of the cell wall?
- 8 How does Plasmolysis affect cells?
- 9 Differentiate between primary cell wall and secondary cell wall.
- 10 Why do animal cells lack a rigid, square shape?

THE FUNDAMENTAL UNIT OF LIFE

NUCLEUS

(Practice Sheet)

- 1 What is a characteristic feature of eukaryotic cells?
 - A. Nucleoid
 - B. Nuclear membrane
 - C. Nucleolus
 - D. Chromatin
- 2 What is the function of the nucleolus?
 - A. Protein synthesis
 - B. DNA storage
 - C. RNA synthesis
 - D. Cell division
- 3 Which cell type lacks a well-defined nucleus and has nucleoids?
 - A. Eukaryotic cell
 - B. Prokaryotic cell
 - C. Animal cell
 - D. Plant cell
- 4 What is the primary function of the nucleus in cellular reproduction?
 - A. Energy production
 - B. Protein synthesis
 - C. Genetic transmission
 - D. Cell division
- 5 What is the genetic material present in the nucleus?
 - A. Proteins
 - B. RNA
 - C. Chromosomes
 - D. Lipids
- 6 Describe the structure of nucleus.
- 7 What are differences between prokaryotic and eukaryotic cell structures?
- 8 Why is the nuclear membrane important in eukaryotic cells?
- 9 Differentiate between heterochromatin and euchromatin.
- 10 Enumerate the functions of the nucleus in a cell.

THE FUNDAMENTAL UNIT OF LIFE**CYTOPLASM****(Practice Sheet)**

- 1 What is the function of cytoplasm in a cell?**
 - A. Energy production
 - B. Storage of genetic material
 - C. Exchange of materials between cell organelles
 - D. Photosynthesis
- 2 Which organelle is responsible for the synthesis of ATP in eukaryotic cells?**
 - A. Golgi apparatus
 - B. Endoplasmic reticulum
 - C. Mitochondria
 - D. Lysosomes
- 3 Which of the following is a function of the smooth endoplasmic reticulum?**
 - A. Protein synthesis
 - B. Lipid synthesis
 - C. Detoxification
 - D. Formation of lysosomes
- 4 What is the primary function of the Golgi apparatus?**
 - A. ATP production
 - B. Protein synthesis
 - C. Modification and packaging of cellular products
 - D. Photosynthesis
- 5 Which type of plastid is involved in photosynthesis in plant cells?**
 - A. Chromoplast
 - B. Leucoplast
 - C. Chloroplast
 - D. Gerontoplast
- 6** What is the main function of the endoplasmic reticulum?
- 7** Differentiate between rough endoplasmic reticulum and smooth endoplasmic reticulum.
- 8** What are the types of plastid found in plant cells?
- 9** Describe the structure and function of mitochondria.
- 10** Describe the role of peroxisomes in cellular processes.

Multiple Choice Questions

1. Which of the following can be made into crystal?

- (a) A Bacterium
- (b) An Amoeba
- (c) A Virus
- (d) A Sperm

Soln

Answer is (c) A Virus

Explanation:

Viruses are considered as the intermediates between living and non- living as they cannot metabolize or reproduce on their own. For all its processes virus requires a host. Viruses can be stored as crystal like chemicals. Virus crystals are collection of millions of virus cells.

2. A cell will swell up if

- (a) The concentration of water molecules in the cell is higher than the concentration of water molecules in surrounding medium
- (b) The concentration of water molecules in surrounding medium is higher than water molecules concentration in the cell
- (c) The concentration of water molecules is same in the cell and in the surrounding medium
- (d) Concentration of water molecules does not matter

Soln:

Answer is (b) The concentration of water molecules in surrounding medium is higher than water molecules concentration in the cell.

Explanation:

When the concentration of water molecules in surrounding medium is higher than water molecules concentration in the cell water from the surrounding enters the cell through osmosis and the cell swells up.

3. Chromosomes are made up of

- (a) DNA
- (b) protein
- (c) DNA and protein
- (d) RNA

Soln:

Answer is (c) DNA and protein

4. Which of these options are not a function of Ribosomes?

- (i) It helps in manufacture of protein molecules
- (ii) It helps in manufacture of enzymes
- (iii) It helps in manufacture of hormones
- (iv) It helps in manufacture of starch molecules
- (a) (i) and (ii)
- (b) (ii) and (iii)
- (c) (iii) and (iv)
- (d) (iv) and (i)

Soln:

Answer is (c) (iii) and (iv)

Explanation:

Proteins are produced in ribosomes hence they are called as protein factories. Enzymes are proteins. Hormones and starch are not produced in ribosome hence option (iii) and (iv) are wrong statements.

5. Which of these is not related to endoplasmic reticulum?

- (a) It behaves as transport channel for proteins between nucleus and cytoplasm
- (b) It transports materials between various regions in cytoplasm
- (c) It can be the site of energy generation
- (d) It can be the site for some biochemical activities of the cell

Soln:

Answer is (c) It can be the site of energy generation

Explanation:

Energy is produced in the Mitochondria hence option c is not related to Endoplasmic reticulum.

6. Following are a few definitions of osmosis Read carefully and select the correct definition

- (a) Movement of water molecules from a region of higher concentration to a region of lower concentration through a semipermeable membrane
- (b) Movement of solvent molecules from its higher concentration to lower concentration
- (c) Movement of solvent molecules from higher concentration to lower concentration of solution through a permeable membrane
- (d) Movement of solute molecules from lower concentration to higher concentration of solution through a semipermeable membrane

Soln:

Answer is (a) Movement of water molecules from a region of higher concentration to a region of lower concentration through a semipermeable membrane

Explanation:

Osmosis is a special type of diffusion in which water molecules move from a region of higher concentration to a region of lower concentration through a semipermeable membrane.

Option b) Movement of solvent molecules from its higher concentration to lower concentration is called as diffusion.

7. Plasmolysis in a plant cell is defined as

- (a) break down (lysis) of plasma membrane in hypotonic medium
- (b) shrinkage of cytoplasm in hypertonic medium
- (c) shrinkage of nucleoplasm
- (d) none of them

Soln:

Answer is (b) shrinkage of cytoplasm in hypertonic medium

Explanation:

Living plant cell loses water through osmosis resulting in shrinkage or contraction of the contents of the cell away from the cell wall. This phenomenon is known as plasmolysis.

When plant cell has more water content than in the surrounding plant cell tend to transfer water to its surroundings which results in shrinkage of the cell through plasmolysis.

8. Which of the following are covered by a single membrane?

- (a) Mitochondria
- (b) Vacuole
- (c) Lysosome
- (d) Plastid

Soln:

Answer is (c) Lysosome

Explanation:

Mitochondria, Vacuole and plastids are covered by double layered membranes hence Lysosome is the answer.

9. Find out the false sentences

- (a) Golgi apparatus is involved with the formation of lysosomes
- (b) Nucleus, mitochondria and plastid have DNA; hence they are able to make their own structural proteins
- (c) Mitochondria is said to be the power house of the cell as ATP is generated in them.
- (d) Cytoplasm is called as protoplasm

Soln:

Answer is (a) Golgi apparatus is involved with the formation of lysosomes

Explanation:

Golgi apparatus has role in storage and synthesis of certain biomolecules .They do not have any role in the synthesis of Lysosome hence option a) is the right answer.

10. Find out the correct sentence

- (a) Enzymes packed in Lysosomes are made through RER (rough endoplasmic reticulum)
- (b) Rough endoplasmic reticulum and smooth endoplasmic reticulum produce lipid and protein respectively
- (c) Endoplasmic reticulum is related with the destruction of plasma membrane
- (d) Nucleoid is present inside the nucleoplasm of eukaryotic nucleus

Soln:

Answer is (a) Enzymes packed in Lysosomes are made through RER (rough endoplasmic reticulum).

Explanation:

RER has ribosomes present on its surface which are responsible for the synthesis of proteins and enzymes are the proteins. Hence option a) is correct.

Rough endoplasmic reticulum has no role in the production of lipid. Similarly Endoplasmic reticulum has no role in the destruction of plasma membrane.

Nucleoid is undefined nuclear region in prokaryotes.

11. Which cell organelle plays a crucial role in detoxifying many poisons and drugs in a cell?

- (a) Golgi apparatus
- (b) Lysosomes
- (c) Smooth endoplasmic reticulum
- (d) Vacuoles

Soln:

Answer is (c) Smooth endoplasmic reticulum

Explanation:

SER plays an important role in detoxifying many poisons and drugs in the liver cells of vertebrates.

12. The proteins and lipids, essential for building the cell membrane, are manufactured by

- (a) rough endoplasmic reticulum
- (b) golgi apparatus
- (c) plasma membrane
- (d) mitochondria

Soln:

Answer is (a) rough endoplasmic reticulum

Explanation:

Endoplasmic reticulum plays important role in the production of both lipids and proteins. SER produces proteins and RER produces lipids.

13. The undefined nuclear region of prokaryotes are also known as

- (a) nucleus
- (b) nucleolus
- (c) nucleic acid
- (d) nucleoid

Soln:

Answer is (d) nucleoid

14. The cell organelle involved in forming complex sugars from simple sugars are

- (a) endoplasmic reticulum
- (b) ribosomes
- (c) plastids
- (d) golgi apparatus

Soln:

Answer is (d) golgi apparatus

Explanation:

Golgi apparatus is involved in the packaging and transport of many biomolecules such as proteins, lipids and carbohydrates.

15. Which out of the following is not a function of vacuole?

- (a) Storage
- (b) Providing turgidity and rigidity to the cell
- (c) Waste excretion
- (d) Locomotion

Soln:

Answer is (d) Locomotion

Explanation:

Vacuoles are responsible for storage, turgidity and rigidity of the cell and waste excretion. Locomotion is carried out by specialised organelles present outside cytoplasm. Vacuoles are present inside the cytoplasm hence option d) is a wrong statement.

16. Amoeba acquires its food through a process, termed

- (a) exocytosis
- (b) endocytosis
- (c) plasmolysis
- (d) exocytosis and endocytosis both

Soln:

Answer is (b) endocytosis

Explanation:

Endocytosis is taking in of matter by a living cell by invagination of its membrane to form a vacuole. In endocytosis, substances that are external to a cell are brought into the cell.

Membrane-bound vesicles containing cellular molecules are transported to the cell membrane in exocytosis. Process of contraction of the protoplast of a plant cell as a resulting in the loss of water from the cell is called as plasmolysis.

17. Cell wall of which one of these is not made up of cellulose?

- (a) Bacteria
- (b) Hydrilla
- (c) Mango tree
- (d) Cactus

Soln:

Answer is (a) Bacteria

Explanation:

Hydrilla, Mango tree and cactus are plants hence their cell wall is made up of cellulose. Cell wall of Bacteria is made of polysaccharide called as Peptidoglycan.

18. Silver nitrate solution is used to study

- (a) endoplasmic reticulum
- (b) golgi apparatus
- (c) nucleus
- (d) mitochondria

Soln:

Answer is (b) golgi apparatus

19. Organelle other than nucleus, containing DNA is

- (a) endoplasmic reticulum
- (b) golgi apparatus
- (c) mitochondria
- (d) lysosome

Soln:

Answer is (c) mitochondria

Explanation:

Mitochondria and Chloroplast are the organelles that have separate nuclear called as mitochondrial DNA and chloroplast DNA.

20. Kitchen of the cell is

- (a) mitochondria
- (b) endoplasmic reticulum
- (c) chloroplast
- (d) golgi apparatus

Soln:

Answer is (c) chloroplast

Explanation:

Food in plants is produced inside Chloroplast hence Chloroplast is known as kitchen of the cell.

21. Lipid molecules in the cell are synthesized by

- (a) smooth endoplasmic reticulum
- (b) rough endoplasmic reticulum
- (c) golgi apparatus (d) plastids

Soln:

Lipid molecules in the cell are synthesized by **smooth endoplasmic reticulum**

22. Cell arises from pre-existing cell was stated by

- (a) Haeckel
- (b) Virchow
- (c) Hooke
- (d) Schleiden

Soln:

Answer is (b) Virchow

23. Cell theory was given by

- (a) Schleiden and Schwann
- (b) Virchow
- (c) Hooke
- (d) Haeckel

Soln:

Answer is (a) Schleiden and Schwann

Explanation:

Schleiden and Schwann were the first to propose the cell theory which stated that all plants and animals are made up of cell and cell is the basic unit of life.

24. The only cell organelle seen in prokaryotic cell is

- (a) mitochondria
- (b) ribosomes
- (c) plastids
- (d) lysosomes

Soln:

Answer is (b) ribosomes

25 . Organelle without a cell membrane is

- (a) ribosome
- (b) golgi apparatus
- (c) chloroplast
- (d) nucleus

Soln:

Answer is (a) ribosome

Explanation:

Golgi bodies, Chloroplast and nucleus are membrane bound organelles and ribosomes are organelles without membrane.

26. $1\ \mu\text{m}$ is

- (a) $10^{-6}\ \text{m}$
- (b) $10^{-9}\ \text{m}$
- (c) $10^{-10}\ \text{m}$
- (d) $10^{-3}\ \text{m}$

Soln:

Answer is (a) $10^{-6}\ \text{m}$

Explanation:

$10^{-3}\ \text{m}$ - millimetre
 $10^{-6}\ \text{m}$ - Micrometer
 $10^{-9}\ \text{m}$ - nanometer

27. Lysosome arises from

- (a) endoplasmic reticulum
- (b) golgi apparatus
- (c) nucleus
- (d) mitochondria

Soln:

Answer is (b) golgi apparatus

Explanation:

Main function of golgi apparatus is secretion, packaging and modification of proteins. It is also involved in synthesis of new membranes and lysosomes.

28. Living cells were discovered by

- (a) Robert Hooke
- (b) Purkinje
- (c) Leeuwenhoek
- (d) Robert Brown

Soln:

Answer is (c) Leeuwenhoek

Explanation:

Robert hook first observed cells but he observed dead cork cell and it was Leeuwenhoek who observed living cell from his microscope.

29. Select the odd one out

- (a) The movement of water across a semi permeable membrane is affected by the amount of substances dissolved in it.
- (b) Membranes are made of organic molecules like proteins and lipids
- (c) Molecules soluble in organic solvents can easily pass through the membrane.
- (d) Plasma membranes contain chitin sugar in plants

Soln:

Answer is (d) Plasma membranes contain chitin sugar in plants

Explanation:

Plasma membrane contain sugar is a wrong statement and rest other statements are true. Plant plasma membrane contain cellulose in it.

Short Answer Questions

30. Why are lysosomes known as ‘suicide-bags’ of a cell?

Soln:

Lysosomes are the organelles that has digestive enzymes in them. These enzymes helps in removal of damaged cells. Lysosomes encounter with damaged cell to burst out, releasing digesting enzyme resulting in destruction of damaged cell hence they are called suicide bag of cell.

31. Do you agree that “A cell is a building unit of an organism”. If yes, explain why?

Soln:

Yes, I agree that A cell is a building unit of an organism because all the living beings are made up of cells and cell is the smallest independent unit of living beings.

32. Why does the skin of your finger shrink when you wash clothes for a long time?

Soln:

Soap solution is hypertonic in nature which makes the water move out of the cells in your hand which results in finger shrink when you wash clothes for a long time.

33. Why is endocytosis found in animals only?

Soln:

Endocytosis is found only in animals because cellwall is absent in animals. Due to this, movement of substances inside the cell is easier in animals than in plants.

34. A person takes concentrated solution of salt, after sometime, he starts vomiting. What is the phenomenon responsible for such situation? Explain.

Soln:

Upon consuming salt solution Osmosis process takes place which results in dehydration. This is the reason for vomiting of the person who consumes salt solution.

35. Name any cell organelle which is non membranous

Soln:

Ribosome is the only non-membranous cell organelle.

36. We eat food composed of all the nutrients like carbohydrates, proteins, fats, vitamins, minerals and water. After digestion, these are absorbed in the form of glucose, aminoacids, fatty acids, glycerol etc. What mechanisms are involved in absorption of digested food and water?

Soln:

Absorption and digestion involves diffusion and osmosis respectively.

37. If you are provided with some vegetables to cook. You generally add salt into the vegetables during cooking process. After adding salt, vegetables release water. What mechanism is responsible for this?

Soln:

After adding salt vegetables release water due to process of **osmosis**.

Explanation:

When we add salt surrounding will be hypertonic and water is released from vegetables to maintain equilibrium.

38. If cells of onion peel and RBC are separately kept in hypotonic solution, what among the following will take place? Explain the reason for your answer.

- (a) Both the cells will swell.
- (b) RBC will burst easily while cells of onion peel will resist the bursting to some extent.
- (c) a and b both are correct.
- (d) RBC and onion peel cells will behave similarly.

Soln:

(c) a and b both are correct.

Explanation:

When surrounding medium is hypotonic water moves into the cell. This lead to swelling of cells. RBC do not have plasma membrane and they swell and burst easily. Plant cell have cell wall which will prevent them from bursting.

39. Bacteria do not have chloroplast but some bacteria are photoautotrophic in nature and perform photosynthesis. Which part of bacterial cell performs this?

Soln:

Small vesicles associated with plasma membrane are present in bacteria. These vesicles have pigment which can trap sunlight to carry photosynthesis.

40. Match the following A and B

(A)

- (a) Smooth endoplasmic reticulum
- (b) Lysosome
- (c) Nucleoid
- (d) Food vacuoles
- (e) Chromatin material

(B)

- (i) Amoeba
- (ii) Nucleus
- (iii) Bacteria
- (iv) Detoxification
- (v) Suicidal bag and nucleolus

Soln:

(A)

- (a) Smooth endoplasmic reticulum
- (b) Lysosome
- (c) Nucleoid
- (d) Food vacuoles
- (e) Chromatin material

(B)

- (iv) Detoxification
- (v) Suicidal bag and nucleolus
- (iii) Bacteria
- (i) Amoeba
- (ii) Nucleus

41. Write the name of different plant parts in which chromoplast, chloroplast and leucoplast are present.

Soln:

Chromoplast- Flower and fruit-

Chloroplast- leaves

Leucoplast-Root

42. Name the organelles which show the analogy written as under

- (a) Transporting channels of the cell——
- (b) Power house of the cell——
- (c) Packaging and dispatching unit of the cell——
- (d) Digestive bag of the cell——
- (e) Storage sacs of the cell——
- (f) Kitchen of the cell——
- (g) Control room of the cell——

Soln:

Answers

- a) Endoplasmic reticulum
- b) Mitochondria
- c) Golgi apparatus
- d) Lysosomes
- e) Vacuoles
- f) Chloroplast
- g) Nucleus

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43. How is a bacterial cell different from an onion peel cell?

Soln:

Bacterial Cell	Onion Peel
Prokaryotic cell	Eukaryotic cell
Lack of organized nucleus, the genetic material present in the form of nucleoid.	Well organised Nucleus
Nuclear membrane absent	Nuclear membrane present
Only a single chromosome is present	More than one chromosome are present
Membrane-bound organelles absent.	Membrane-bound organelles present.
Nucleolus is absent	Nucleolus is present.
Cell division takes place by fission or budding.	Cell division takes place by mitosis or meiosis

44. How do substances like carbon dioxide (CO₂) and water (H₂O) move in and out of the cell?

Soln:

Substances like carbon dioxide (CO₂) and water (H₂O) move in and out of the cell through **Osmosis**.

45. How does amoeba obtain its food?

Soln:

Amoeba obtain its food through **endocytosis**.

Explanation:

Amoeba surround food particle by its pseudopodia. It ingest the food and water particle to form a food vacuole. This process is known as endocytosis.

46. Name the two organelles in a plant cell that contain their own genetic material and ribosomes.

Soln:

Chloroplast and Mitochondria are the two organelles in a plant cell that contain their own genetic material and ribosomes.

47. Why are lysosomes also known as “scavengers of the cells”?

Soln:

Lysosomes also known as “scavengers of the cells” because lysosomes have lytic enzymes which are used to destroy pathogens and worn out cells. Lysosomes also destroys waste materials which are harmful for the cell.

48. Which cell organelle controls most of the activities of the cell?

Soln:

Nucleus controls most of the activities of the cell.

49. Which kind of plastid is more common in

- (a) roots of the plant
- (b) leaves of the plant
- (c) flowers and fruits

Soln:

Answers

- a) **Leucoplasts** are more common in roots of the plant
- b) **Chloroplasts** are more common in leaves of the plant
- c) **Chromoplasts** are more common in flowers and fruits

50. Why do plant cells possess large sized vacuole?

Soln:

Cells possess large sized vacuole because vacuoles not only stores important material but also contain sap that give turgidity to the cell.

51. How are chromatin, chromatid and chromosomes related to each other?

Soln:

Chromatin are the thread like structures which form the chromosomes.

A copy of duplicated chromosome which is generally joined to the other copy by a centromere is called **Chromatid**.

Chromosomes : When a cell starts to divide, the tangled mass of chromatin condense into long threads and finally, rod-like bodies called chromosomes.

52. What are the consequences of the following conditions?

- (a) A cell containing higher water concentration than the surrounding medium
- (b) A cell having low water concentration than the surrounding medium.
- (c) A cell having equal water concentration to its surrounding medium.

Soln:

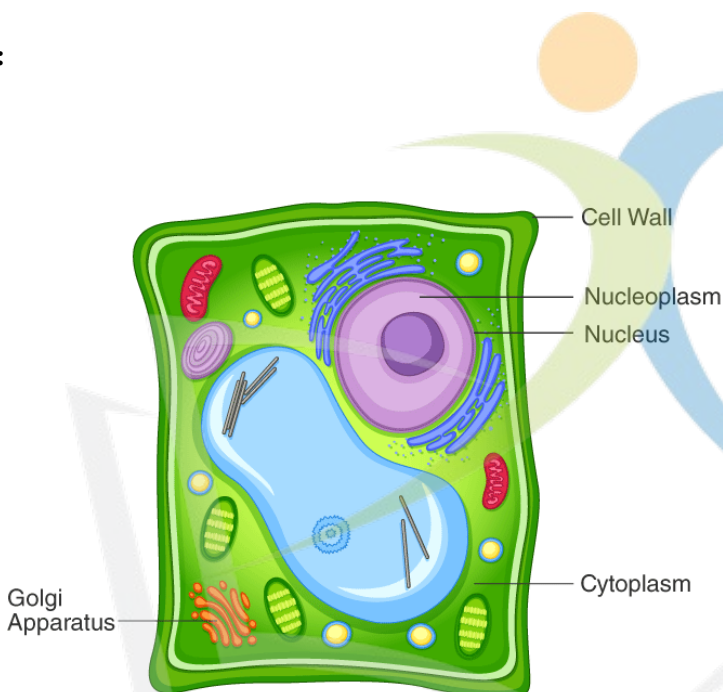
- a) If a cell contains higher water concentration than the surrounding medium then cell loses water and it shrinks. This process is called exosmosis.
- b) If a cell has having low water concentration than the surrounding medium cell intakes water from the surrounds and cell bursts. This process is called endosmosis.
- c) If A cell having equal water concentration to its surrounding medium then there will be no change in the cell.

Long Answer Questions

53. Draw a plant cell and label the parts which

- (a) determines the function and development of the cell**
- (b) packages materials coming from the endoplasmic reticulum**
- (c) provides resistance to microbes to withstand hypotonic external media without bursting**
- (d) is site for many biochemical reactions necessary to sustain life.**
- (e) is a fluid contained inside the nucleus**

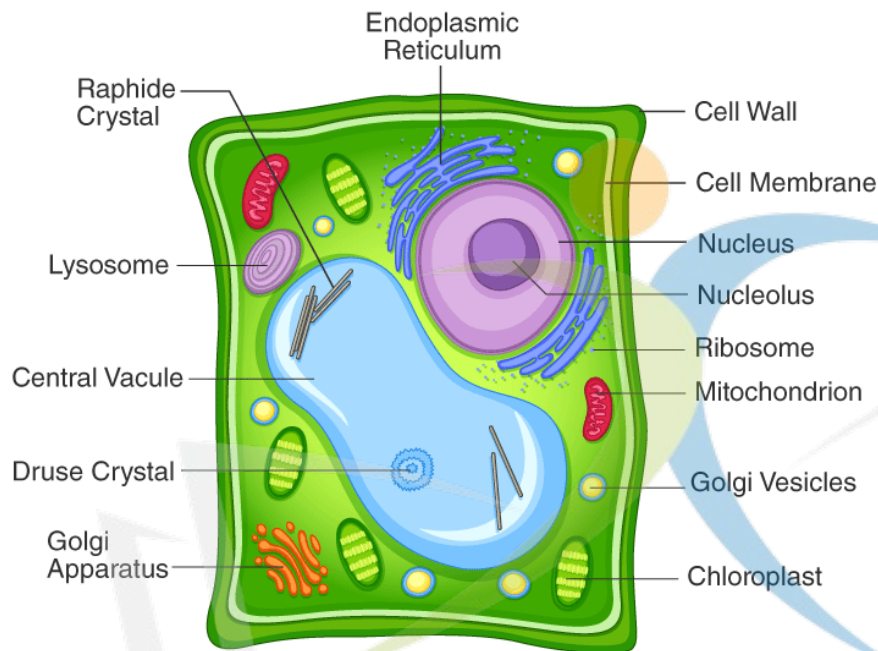
Soln:



- (a) Nucleus: It determines the function and development of the cell
- (b) Golgi apparatus: It packages materials coming from the endoplasmic reticulum
- (c) Cell wall: It provides resistance to microbes to withstand hypotonic external media without bursting
- (d) Cytoplasm: It is a site for many biochemical reactions necessary to sustain life.
- (e) Nucleoplasm: It is a fluid contained inside the nucleus

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54. Illustrate only a plant cell as seen under electron microscope. How is it different from animal cell?
Soln:



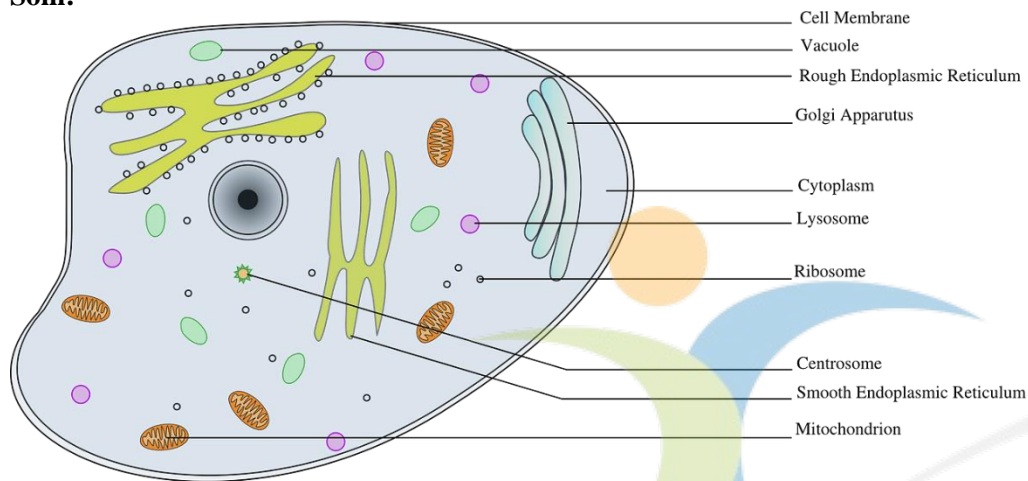
Major differences between a plant cell and animal cell are

- (i) Chloroplast in plant cell but absent in animal cells
- (ii) large central vacuole in plant cell which is absent in animal cells
- (iii) Cell wall is present in plant cell and absent in animal cells.

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55. Draw a neat labelled diagram of an animal cell.

Soln:

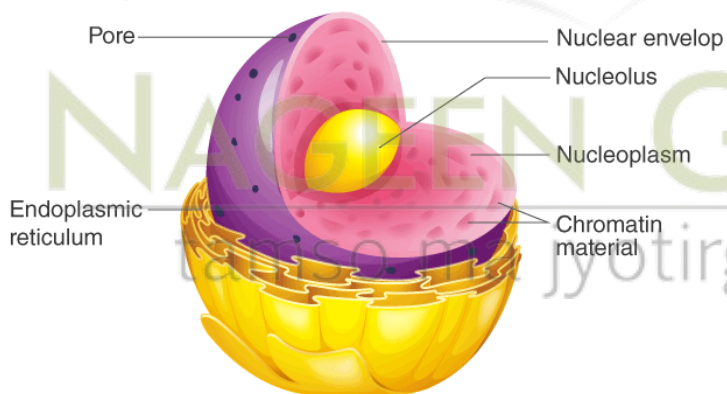


Cross Section of an Animal Cell

56. Draw a well labelled diagram of an eukaryotic nucleus. How is it different from nucleoid?

Soln:

Nucleus is an organelle present in the cell whereas Nucleoid is a small spot present in the cytoplasm of the cell. Nucleus is well organized and large whereas nucleoid is poorly organized and it is very small. Nucleus contains many chromosomes but Nucleoid contains single circular DNA molecule.



57. Differentiate between rough and smooth endoplasmic reticulum. How is endoplasmic reticulum important for membrane biogenesis?

Soln:

Rough Endoplasmic reticulum	Smooth Endoplasmic reticulum
RER Looks rough under Microscope	SER varies greatly in appearance in different cells
Robosomes are present on all active cells	Ribosomes are not present on SER
They are the sites of protein manufacturing	helps in manufacture of fat molecules
Proteins are transported to various sites from here	Detoxification of drug takes place

58. In brief state what happens when

(a) dry apricots are left for sometime in pure water and later transferred to sugar solution?

(b) a Red Blood Cell is kept in concentrated saline solution?

(c) the Plasma-membrane of a cell breaks down?

(d) rheo leaves are boiled in water first and then a drop of sugar syrup is put on it?

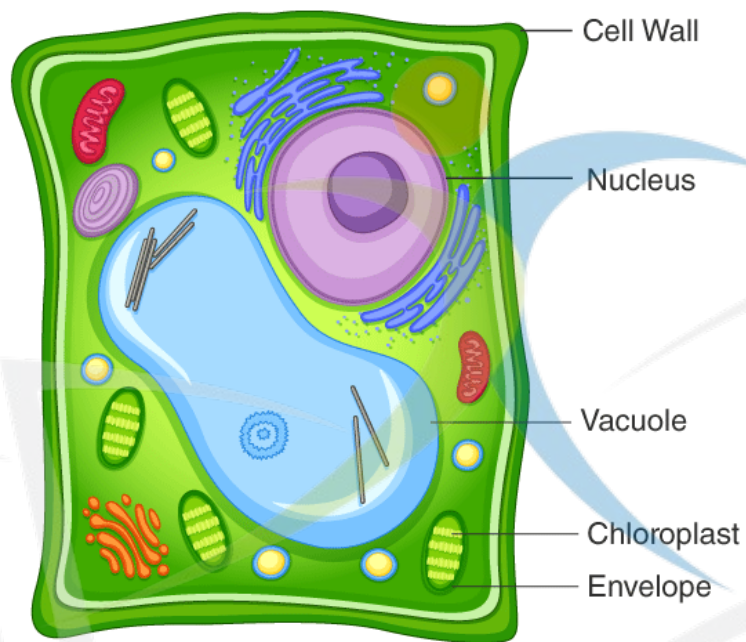
(e) golgi apparatus is removed from the cell?

Soln:

- When we put dried raisins or apricots in plain water and leave them for some time cell gains water and swells. If we put same seeds into a concentrated solution of sugar or salt. You will see it loses water, and consequently shrinks.
- When red blood cell is kept in concentrated saline solution. Cell loses water immediately and shrinks.
- When the plasma membrane of a cell breaks down cell dies.
- On boiling, cells of Rheo leaves are died and if we put sugar solution on it there will not be any intake of water due to lack of osmosis. Here cell undergo plasmolysis concluding only living cells undergo osmosis.
- This stops the formation of vesicles and transport of proteins and lipids is stopped by the removal of Golgi apparatus.

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59. Draw a neat diagram of plant cell and label any three parts which differentiate it from animal cell.



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NCERT TEXTBOOK SOLUTION

Chapter - 5 The Fundamental Unit of Life

Questions:

Q. 1 Who discovered cells and how?

Ans.:

- In 1665, Robert Hooke, a British scientist discovered cells.
- He took a thin slice of cork from an oak tree and observed it under the microscope.
- He observed honeycomb-like compartments bounded by thick walls; hence, named them “cells”.

Q. 2 Why is the cell called the structural and functional unit of life?

Ans.:

- The cell is called the structural unit of life because all the organisms are made up of cells.
- The cell is also known as the functional unit of life because all the things that an organism does are controlled by cells.
- Cells organise and form tissues, which form organs which further form organ systems that perform all the bodily functions.
- Hence a cell is the structural and functional unit of life.

Questions:

Q.1 How do substances like CO_2 and water move in and out of the cell?

Ans.: Diffusion is the process by which particles move from a region of higher concentration to a region of lower concentration, until uniform concentration is finally achieved. Carbon dioxide (CO_2) moves in and out of the cells by the process of diffusion.

Osmosis is a special type of diffusion. Osmosis is diffusion of water from the region of its higher concentration (pure water or dilute solution) to the

region of its lower concentration (strong solution) through a semipermeable membrane. Water moves in and out of the cells by osmosis.

Both diffusion and osmosis are physical or mechanical processes and do not require spending of energy for their performance by the cells. They are both gradient dependent processes.

Q.2 Why is plasma membrane called a selectively permeable membrane?

Ans.:

- The cell membrane is also known as the plasma membrane.
- It is the outermost covering of the cell that separates the contents inside of the cell from its outside environment.
- Plasma membrane only allows some materials, like some small molecules and water molecules, to enter the cell or leave from the cell.
- Not everything that comes in contact with the cell membrane can enter the cell because of this.
- So, the plasma membrane is known as a selectively permeable membrane. It selects or chooses what goes in and out of the cell.

Questions:

Q.1 Fill in the gaps in the following table illustrating differences between prokaryotic and eukaryotic cells.

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Ans.:

prokaryotic cell	eukaryotic cell
1. Size : Generally small (1-10 μ m); 1 μ m = 10 ⁻⁶ m	1. Size : Generally large (5-100 Mm)
2. Nuclear region : And known as	2. Nuclear region : Well defined and surrounded by a nuclear membrane
3. Chromosome :single	3. Chromosome : more than one
4. Membrane – bound Organelles :absent	4.

Exercise

Questions:

Q. 1 Can you name the two organelles we have studied that contain their own genetic material?

Ans.: Mitochondria and Plastids are two cell organelles that contain their own genetic material. They are also known as Semi-Autonomous organelles as they have their own DNA(Genetic Material) and Ribosomes.

Q.2 If the organization of a cell is destroyed due to some physical and chemical influence, what will happen?

Ans.: Cell is the smallest unit of a life which is able to perform all basic

functions of life. If the organisation of a cell is destroyed due to some physical and chemical influence, it will not be able to perform all living functions like respiration, nutrition, excretion, etc. and the cell will ultimately die.

Q.3 Why are lysosomes known as suicide bags?

Ans.:

- Lysosomes are the waste disposal system of the cell.
- They help to keep the cell clean by digesting any foreign materials or worn out cell organelles.
- Lysosomes contain a powerful digestive enzyme capable of digesting all organic materials.
- Lysosomes are also known as "Suicide Bags" because whenever there is some disturbance in cell metabolism or when the cell gets damaged, the lysosomes burst themselves resulting in the digestion of their own cell by the digestive enzymes.

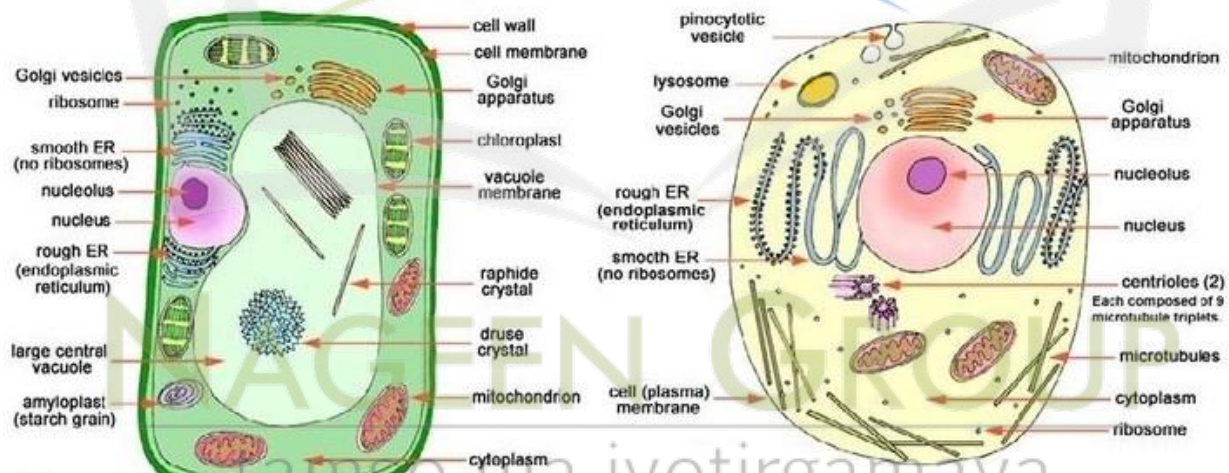
Q. 4 Where are proteins synthesized inside the cell?

Ans.: Ribosomes are the sites of protein synthesis. They are small and dense particles which occur freely in the cytosol or remain attached to the endoplasmic reticulum. They take part in the synthesis of proteins.

Q.1 Make a comparison and write down ways in which plant cells are different from animal cells.

Ans.: Difference between plant cell and animal cell:

Plant cell	Animal cell
It is usually larger in size.	It is smaller than plant cell.
Plasma membrane is surrounded by rigid non-living cell wall made up of cellulose.	Cell wall is absent.
The vacuoles are well developed. In a mature plant cell, usually a single large vacuole is present.	Vacuoles either are absent or if present are small in size.
Centrosome and centrioles are absent.	Centrosome and centrioles are present.
They contain chloroplast	They don't have chloroplast
Plastids are present.	Plastids are absent.



Q.2 How is a prokaryotic cell different from a eukaryotic cell?

Ans.:

Prokaryotic cell	Eukaryotic cell
Lack of organized nucleus, the genetic material present in the form of nucleoid.	Nucleus well organized.
Nuclear membrane absent.	Nuclear membrane present.
Only a single chromosome is present	More than one chromosome is present
Membrane-bound organelles absent.	Membrane-bound organelles present.
Nucleolus is absent.	Nucleolus is present.
Cell division takes place by fission or budding.	Cell division takes place by mitosis or meiosis.
Size of cell is small	Size of cell is generally large
Example:-Bacterial, blue green algae.	Example:-Plant, animal, fungi.

Q.3 What would happen if the plasma membrane ruptures or break down?

Ans.:

- Plasma membrane is the outer covering of the cell.
- It is semi permeable in nature. This means that it allows only certain molecules to enter or leave the cell.
- If the plasma membrane is ruptured, the cell content (the cytoplasm and organelles) will get displaced and the cell will die.
- No kind of cell uptake would be possible, this means no osmosis or diffusion.

Q.4 What would happen to the life of a cell if there was no Golgi apparatus?

Ans.:

If there was no Golgi apparatus in the cell, the following cell activities would be affected:

- (i) Formation of lysosomes
- (ii) Packaging and dispatching of material synthesized near endoplasmic reticulum to various targets inside/outside cells
- (iii) The formation of cell plate and cell membrane
- (iv) Storage, modification and packaging of products in vesicles

Q.5 Which organelle is known as the powerhouse of the cell? Why?

Ans.:

- The mitochondria are known as the powerhouse of the cell. (Singular: Mitochondrion; Plural: Mitochondria)
- Reason: ATP synthesis takes place in the mitochondria.
- ATP molecules (Adenosine Triphosphate) are the energy molecules.
- ATP molecules store and transport chemical energy within cells which they use to carry out the different processes.

Q.6 Where do the lipids and proteins constituting the cell membrane get synthesized?

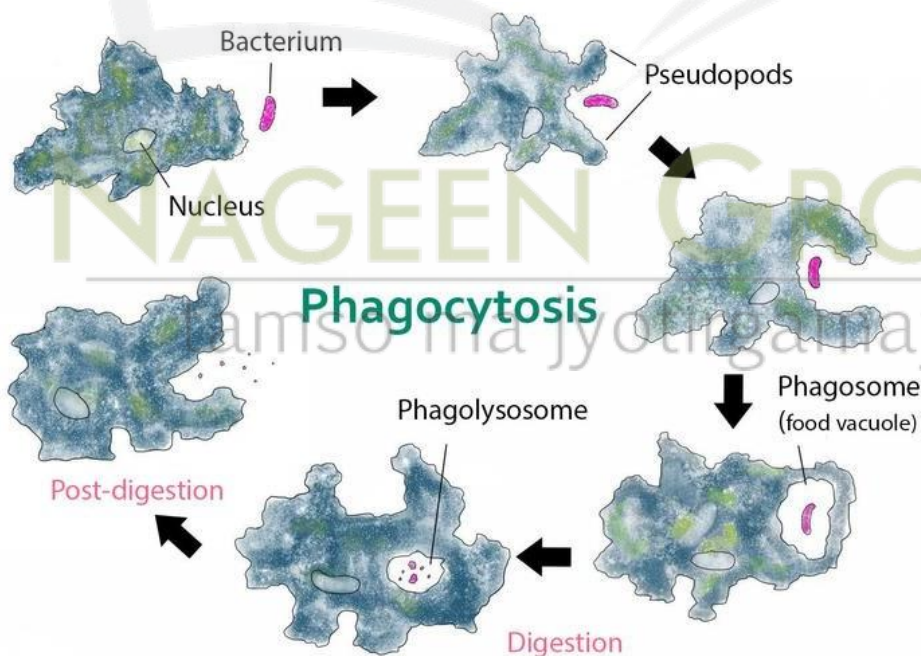
Ans.: The Lipids and Proteins that constitute the cell membrane are mainly synthesized in the Endoplasmic Reticulum. There are two types of Endoplasmic Reticulum:-

1. Smooth Endoplasmic Reticulum:- Which is without the presence of ribosomes and is specialized for synthesizing lipids used in cell membrane.

2. Rough Endoplasmic Reticulum:- Which has Ribosomes attached on the outer surface and are specialized to synthesize proteins used in cell membrane

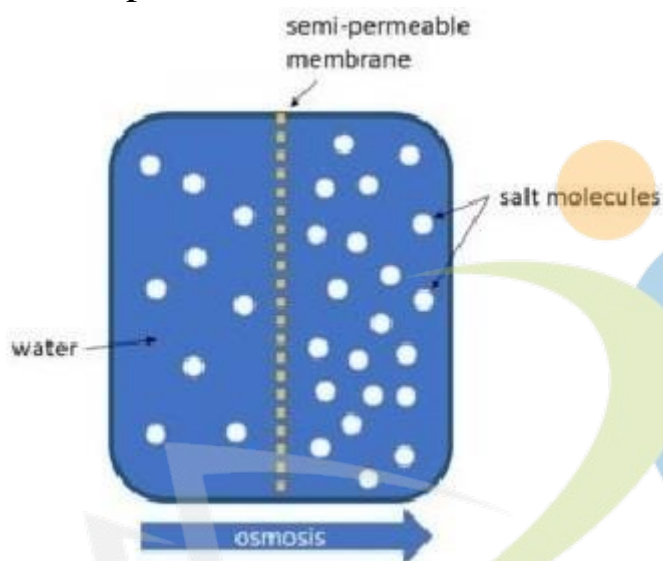
Q.7 How does an Amoeba obtain its food?

Ans.: Amoeba obtains its food through the process of endocytosis. The plasma membrane of Amoeba is flexible, which helps the amoeba to engulf its food particles and other material from its external environment. The flexible plasma membrane that an amoeba uses to capture its prey is known as pseudopodia. (meaning false legs).



Q.8 What is osmosis?

Ans.: Osmosis is a special case of diffusion of water molecules from a region of higher concentration to a region of lower concentration through a semi-permeable membrane. The below diagram shows osmosis:-



Q.9 Carry out the following osmosis experiment:

Take four peeled potato halves and scoop each one out to make potato cups. One of these potato cups should be made from a boiled potato. Put each potato cup into a trough containing water.

Now

- (a) keep cup A empty;
- (b) put one teaspoon sugar in cup B;
- (c) put one teaspoon salt in cup C.
- (d) put one teaspoon sugar in the boiled potato cup D;

Keep these for 2 hours. Then observe the four potato cups and answer the following

- (i) Explain why water gathers in the hollowed portion of B and C.
- (ii) Why is potato A necessary for this experiment?
- (iii) Explain why water does not gather in the hollowed out portions of A and D?

Ans.:

(i) Water gathers in the hollowed portion of unboiled potatoes B and C because the cells of potatoes gained water by endosmosis.

The water moved inside the cell by osmosis (From higher concentration to Lower Concentration).

(ii) Potato cup A is necessary in the experiment as a 'control' for providing comparison with situations created in potato cups B, C and D.

(iii) Water does not gather in the hollowed portion of potato cup A as there is no concentration gradient (differences in concentration of water) as a result of which process of osmosis does not occur thus no water is gathered in the hollowed portion.

Water is not able to enter into potato cup D because potato cup D is a boiled potato cup. Boiling the potato results in the death of cells as a result the membranes of the potato cells lose their permeability and osmosis doesn't occur.

Q.10 Which type of cell division is required for growth and repair of body and which type is involved in formation of gametes?

Ans.:

Cell division: It is the process of formation of two daughter cells from a single cell following a series of steps.

Mitosis:

1. It is also known as equational division because it forms exactly a xerox copy of the previous cell.
2. The DNA amount remains constant and also the chromosome number remains constant in a species.
3. This is the cell division required for growth and repair of the body as it adds up identical cells to a certain part of the body increasing its size.
4. In case of injuries where the cells are damaged, mitosis occurs to repair those regions.

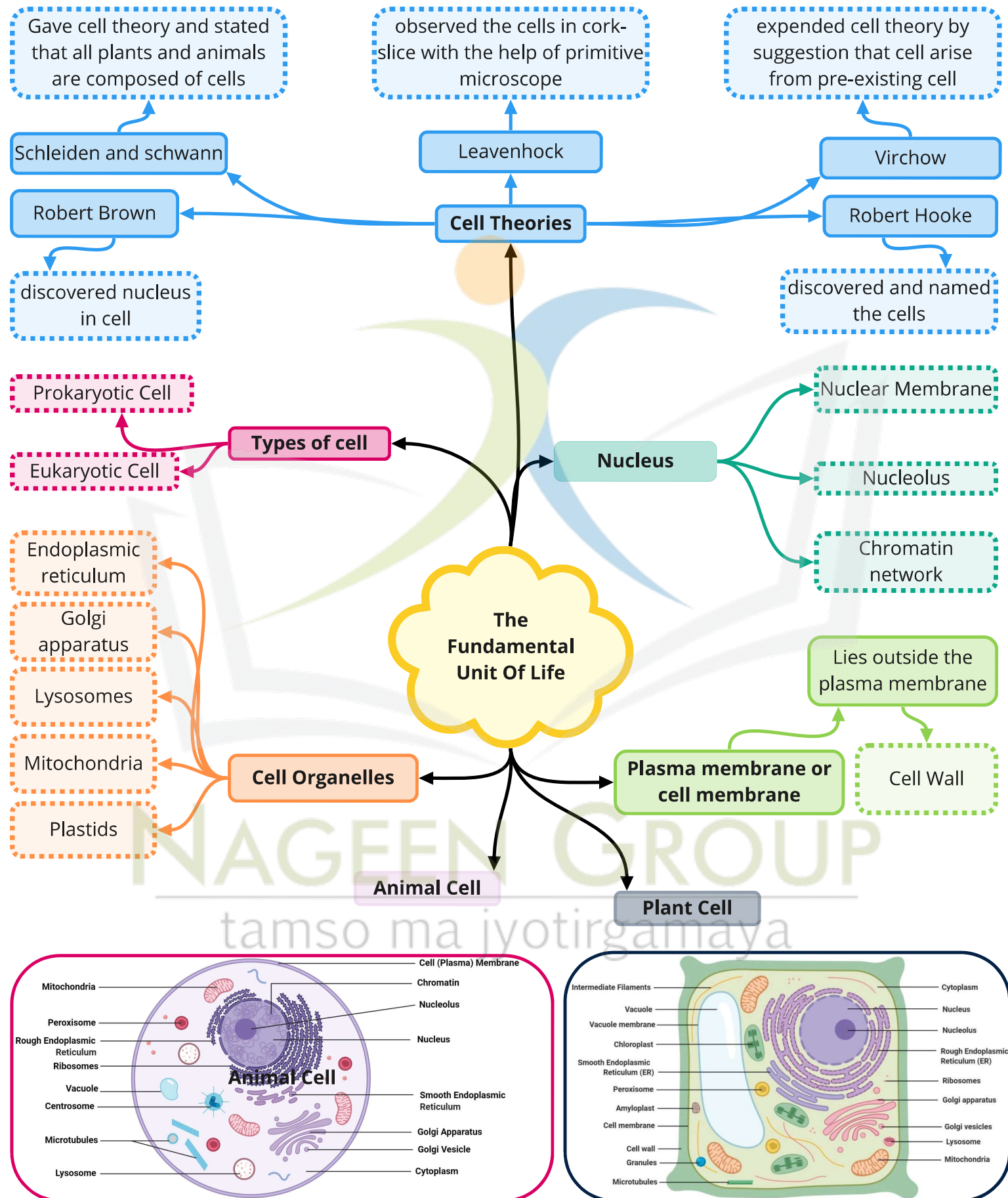
Meiosis:

1. It is known as the reductional division as the chromosome number reduces to half in this type of division.
2. It can form gametes as gametes need to be haploid cells so that they can fuse together in order to form a diploid zygote which will give rise to a new offspring.

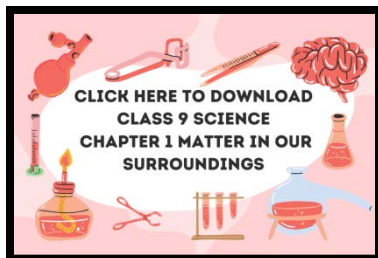


THE FUNDAMENTAL UNIT OF LIFE

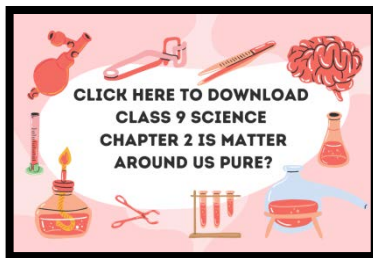
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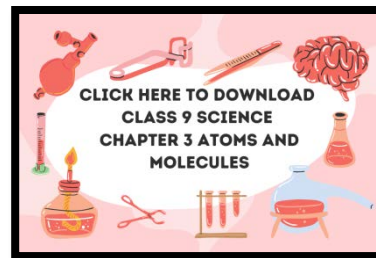
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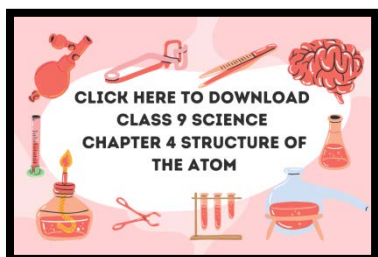
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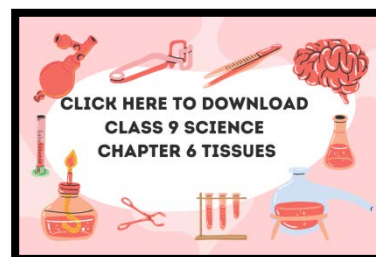
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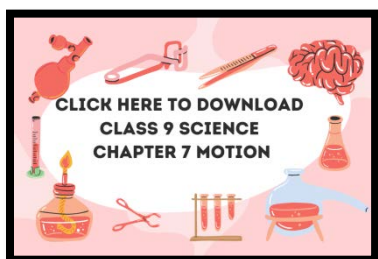
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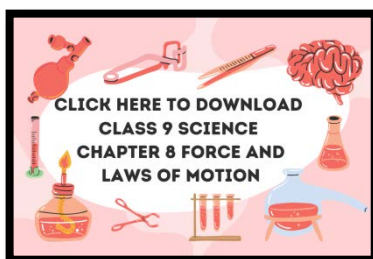
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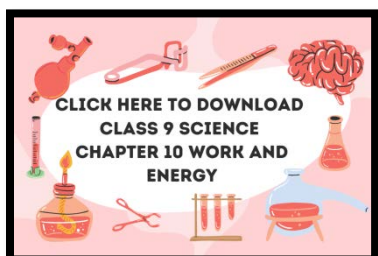
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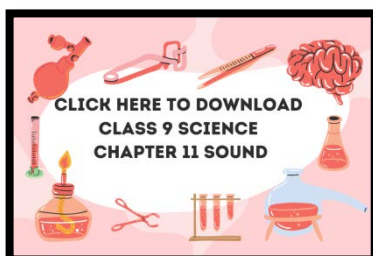
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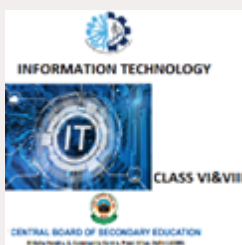
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Financial Literacy



Handicrafts



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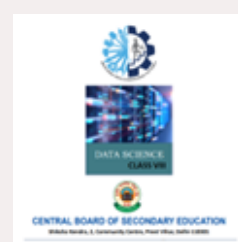
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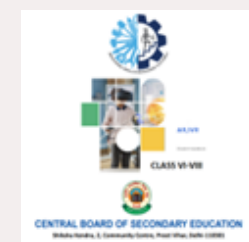
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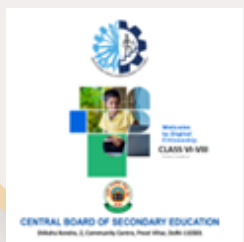
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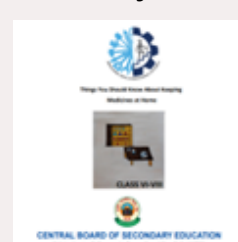
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Digital Citizenship



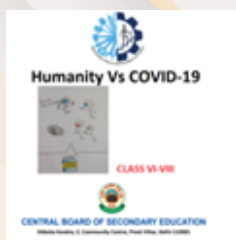
Life Cycle of Medicine & Vaccine



Things you should know about keeping Medicines at home



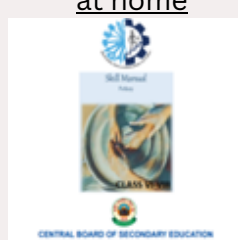
What to do when Doctor is not around



Humanity & Covid-19



Blue Pottery



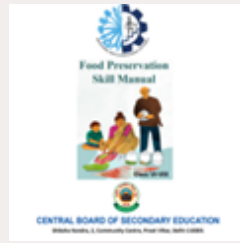
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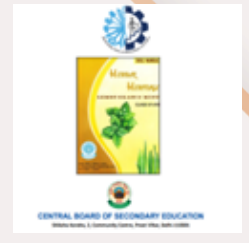
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Food Preservation



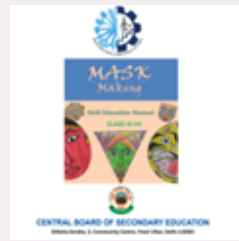
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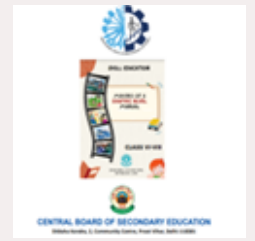
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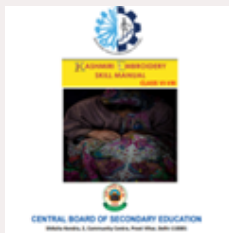
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Mass Media



Making of a Graphic Novel



Kashmiri Embroidery



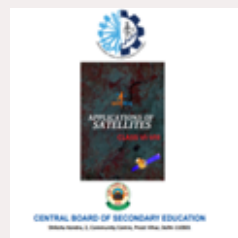
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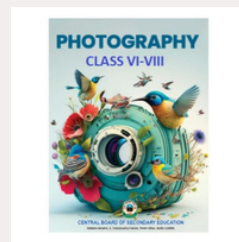
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Application of Satellites

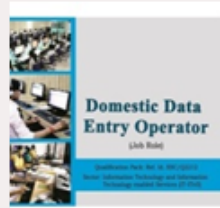


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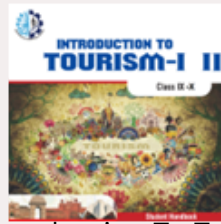
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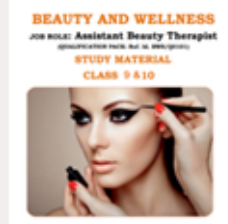
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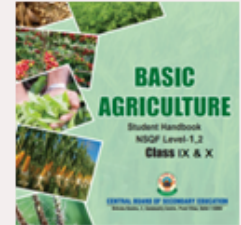
Introduction To Financial Markets



Introduction To Tourism



Beauty & Wellness



Agriculture



Food Production



Front Office Operations



Banking & Insurance



Marketing & Sales



Health Care



Apparel



Multi Media



Multi Skill Foundation Course



Artificial Intelligence



Physical Activity Trainer



Data Science



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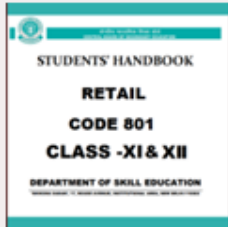


Foundation Skills For Sciences (Pharmaceutical & Biotechnology)(NEW)

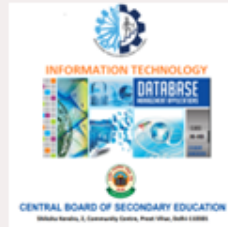


Design Thinking & Innovation (NEW)

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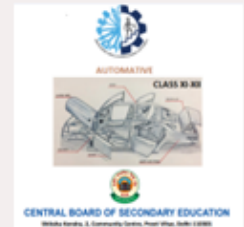
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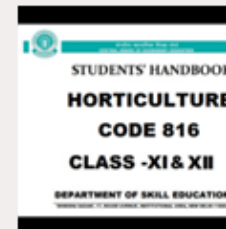
Marketing



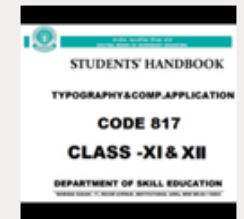
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Insurance



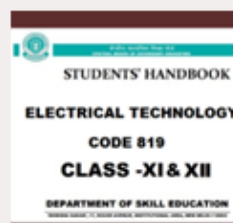
Horticulture



Typography & Comp.
Application



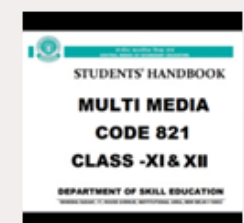
Geospatial Technology



Electrical Technology



Electronic Technology



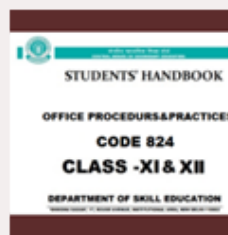
Multi-Media



Taxation



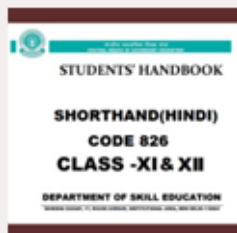
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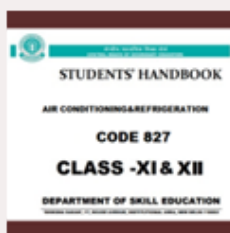
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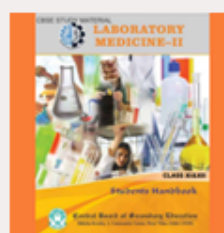
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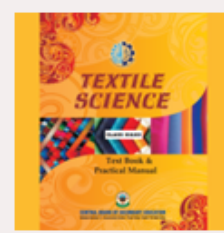
Shorthand (Hindi)



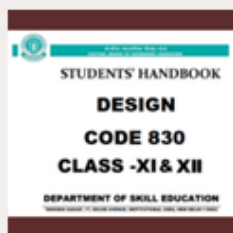
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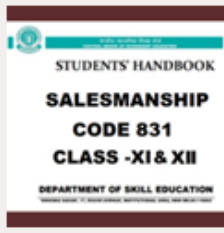
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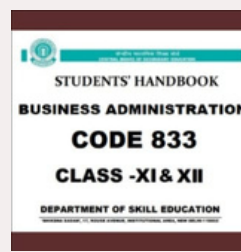
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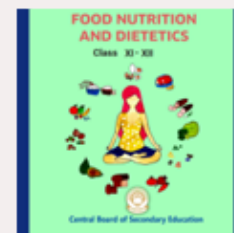
Design



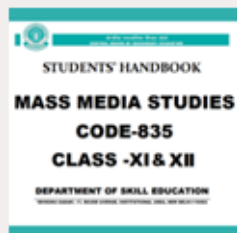
Salesmanship



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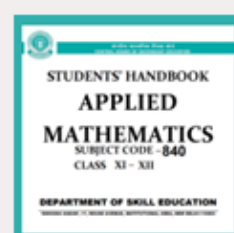
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Library & Information Science



Fashion Studies



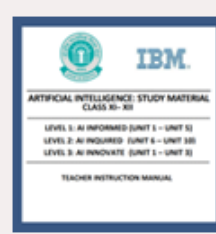
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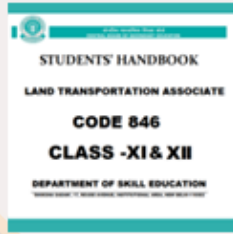
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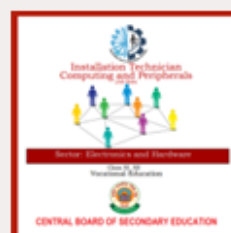
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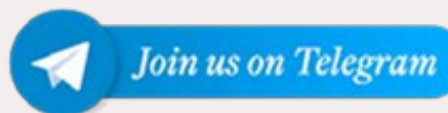
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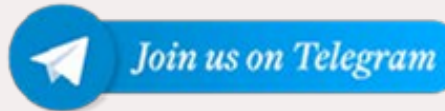
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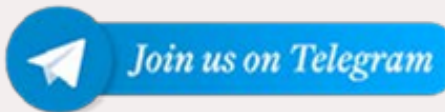
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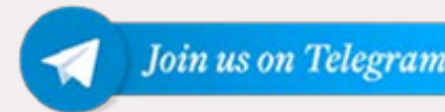
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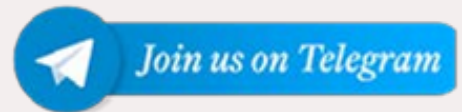
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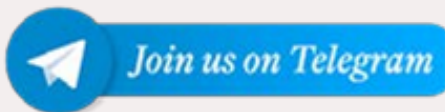
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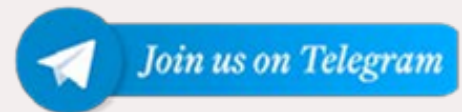
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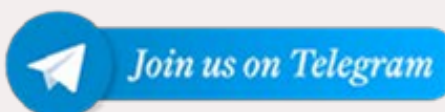
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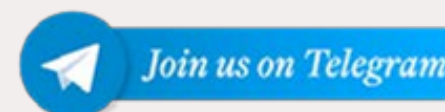
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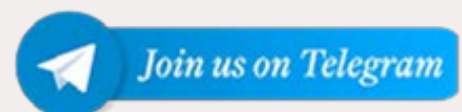
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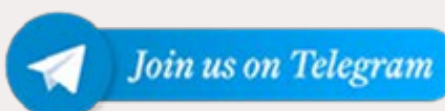
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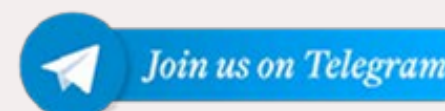
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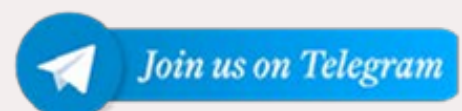
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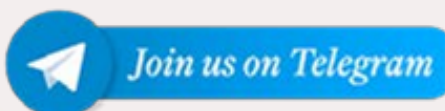
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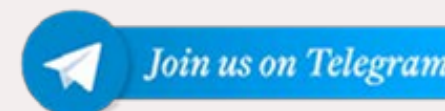
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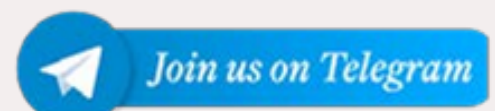
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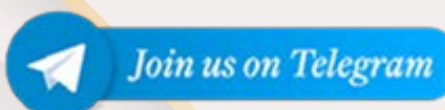
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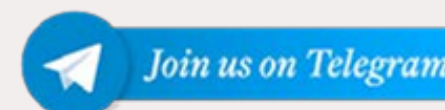
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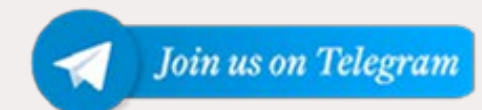
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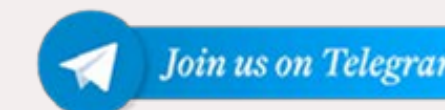
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